

**1X660 MW BHUSAVAL THERMAL POWER STATION
UNIT-6
MAHARASHTRA STATE POWER GENERATION CO. LTD.**

VOLUME – II B & III

**TECHNICAL SPECIFICATION
FOR
PRE TREATMENT PLANT (PT PLANT)**

SPECIFICATION NO.: PE-TS-415-158A-A001 REV 00



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA**



TITLE:

TECHNICAL SPECIFICATION FOR
PRE TREATMENT PLANT (PT PLANT)
1X660 MW BHUSAWAL TPS, UNIT # 6

BHEL DOCUMENTS NO.: PE-TS-415-158A-A001

VOLUME-

SECTION-

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**SECTION - A
INTENT OF SPECIFICATION**

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SCOPE of INQUIRY/ INTENT OF SPECIFICATION:

- 1.1 This specification is intended to cover design, engineering, manufacture, fabrication, assembly, civil design and construction works, inspection & testing at vendor's & sub-vendor's works, painting, forwarding, supply and delivery at site including start up and commissioning spares, mandatory spares, properly packed for transportation, unloading / handling and storage at site, in site transportation, assembly, erection and commissioning, trial run, preparation and submission of "As Built" drawings, site testing, carrying out performance guarantee tests at site and handover of **PRE TREATMENT PLANT (PT PLANT)** including civil design & construction works of Pre Treatment Plant (excluding Chemical house and centrifuge building) as per the details in different sections / volumes of this specification for **1X6600 MW BHUSAWALTPS UNIT-6**.

The bidder's scope shall also include any other services, etc. if called for in the succeeding sections of the specification.

- 1.2 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve them of the responsibility of providing such facilities to complete the supply, erection and commissioning of Pre Treatment Plant within quoted price.
- 1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgment is not in full accordance herewith.
- 1.4 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing.
- 1.5 Items though not specifically mentioned but needed to make the system complete as stipulated under these specifications are also to be furnished unless otherwise specifically excluded.
- 1.6 The general terms and conditions, instructions to tenderer and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification are subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.
- 1.7 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under Vol-III of the specification as "PRE BID CLARIFICATION SCHEDULE". In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of BHEL/Customer shall prevail and shall be complied by the bidder without any commercial and delivery implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by BHEL/ Customer as and when brought to their notice either by the bidder or by BHEL/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.
- 1.8 Deviations, if any, should be very clearly brought out clause by clause in the enclosed schedule; otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification.
- 1.9 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.

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- 1.10 Unless specified otherwise, all through the specification, the word contractor shall have same meaning as successful bidder/vendor and Customer/Purchaser/Employer will mean BHEL and/or Customer (Maharashtra State Power Generation Co. Ltd.) as interpreted by BHEL in the relevant context. Please refer GCC/SCC for better clarity.
- 1.11 The equipment covered under this specification shall not be dispatched unless the same have been finally inspected, accepted and dispatch release issued by BHEL/Customer.
- 1.12 BHEL's/Customer's representative shall be given full access to the shop in which the equipments are being manufactured or tested and all test records shall be made available to him.

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SECTION – B**PROJECT INFORMATION**

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1.0 INTRODUCTION

The proposed 1x 660 MW Bhusawal Thermal Power Project will be set up by Maharashtra State Power Generation Co. Ltd. (MAHAGENCO) in Dipnagar near Bhusawal, Maharashtra, India.

The Bidder shall acquaint himself by a visit to the site, if felt necessary, with the conditions prevailing at site before submission of the bid. The information given herein under is for general guidance and shall not be contractually binding on the Owner. All relevant site data/information as may be necessary shall have to be obtained /collected by the Bidder.

2.0 APPROACH TO SITE

Deepnagar is well connected by rail and road. By road, it is about 8 Km from Bhusawal city. Nearest railway station is at Bhusawal. The nearest Airport is at Aurangabad. The nearest sea port is at Mumbai. The site is located on the Mumbai-Nagpur Highway.

3.0 LAND

Bhusawal Thermal Power Plant is already having 1x62.5 MW + 2x210 MW Units and Two (2) Units of 500 MW each are under execution stage. About 108.94 Hectares of land is acquired by MAHAGENCO near existing TPS. It is proposed to install 1x 660 MW unit on this land.

4.0 SOURCE OF COAL

Indian coal would be sourced from Machaakata coal blocks in Orissa state. The Coal will be received at Plant site directly by rail. The coal from the railway wagons would be unloaded by means of wagon tippers and will be either bunkered or stacked in the stock pile at site.

5.0 SOURCE OF WATER

The main source of water is considered Ozerkheda Reservoir which is located at around 18 km from plant site.

6.0 ASH DISPOSAL AREA

The ash generated from 1 x 660 MW unit shall be disposed off in slurry form to the existing Ash Pond located at Velhala, approx. 12 Km from the site.

7.0 PROJECT INFORMATION

- | | | | |
|-----|-------------------------|---|---|
| 7.1 | Client / Owner | : | Maharashtra State Power Generation Co. Ltd. |
| 7.2 | Consultant | : | Procon Engineers, Navi Mumbai
(Division of Nimoto Consulting Engineers Pvt. Ltd.) |
| 7.3 | Project Title | : | BHUSAWAL T.P.S. UNIT – 6 : 1X660 MW |
| 7.4 | Location | : | Dipnagar, Near Bhusawal, Maharashtra, India |
| 7.5 | Nearest railway station | : | Bhusawal |
| 7.6 | Nearest Airport | : | Aurangabad |

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- 7.7 Nearest Harbour : Mumbai
- 7.8 Access Roads : NH 6 (Mumbai-Nagpur Highway)
- 7.9 Elevation above MSL : 210 M
- 7.10 Longitude/latitude : 75 ° 51' 10" East / 21° 02' 30" North
- 7.11 Seismic Zone : Zone III as per IS:1893
- 7.12 AMBIENT TEMPERATURE
- 7.12.1 Mean of daily maximum temperature : 48.25 °C (during May)
- 7.12.2 Mean of daily minimum temperature : 18 °C (during January)
- 7.12.3 Highest recorded temperature : 48.7°C
- 7.12.4 Lowest recorded temperature : 13°C
- 7.13 Wet bulb temperature : 27°C (Maximum)
- 7.14 Rainfall : One hour rainfall intensity, derived from 50 years return period, as per recommendations of Indian meteorological department shall be considered for the design of storm water drainage system. [and Rainfall intensity data shall be collected from Meteorological dept. by the bidder.
- 7.15 Wind Speed : 0 to 39 Km/hr . Basic wind speed is 39/m/s as per IS:875 Part-III
- 7.16 Wind direction : East North East to West South West

ELECTRICAL

- 7.17 As per CEA guide lines and technical specification for 500 MW & higher ratings TG set
- 7.17.1 Rated Voltage : 400kV
- 7.17.2 Voltage variation : $\pm 5 \%$
- 7.17.3 Frequency Variation : +3 % to - 5 %
- 7.17.4 Rated Short Circuit Level : 50 kA, Three Phase
- 7.18 AUXILIARY POWER SUPPLY

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Auxiliary electrical equipment shall be suitable for operation on the following supply system:

- | | | | |
|--------|---|---|---|
| 7.18.1 | Motors above 1000 kW & other Power devices | : | 11kV,3Ph,3wire,50Hz system |
| 7.18.2 | Motors below 1000 kW & above 160kW & other power devices | : | 3.3kV, 3 ph, 3 wire 50 Hz, Non Effectively earthed |
| 7.18.3 | Motors upto 160 kW & other power devices | : | 415V, 3 ph, 4 wire 50 Hz |
| 7.18.4 | Motor Starting Methods | : | Direct on Line |
| 7.18.5 | (a) Lighting fixtures Space heaters, and single Phase motors | : | 240V, 1 phase, 50 Hz
Supply through suitably rated transformers to limit the short circuit level to 9kA – 1 sec. |
| | (b) Control & Instrumentation | : | 240V, 1 Phase, 50 Hz from UPS |
| 7.18.6 | Short circuit levels of 11kV, 3.3 kV and 415V system equipments | | |

The equipment shall be suitable for the following short circuit levels

- | | | | |
|--------|---|---|---|
| (a) | 11kV Switchgears | : | 44 kA/3 sec
Emergency Power from Plant Main DG (MCC) will not be provided for Fire Water Pumps. However, Diesel engine driven Fire Pump will be provided separately under Fire Protection Package. |
| (b) | 3.3kV Switchgears | : | 40 kA/3sec |
| (c) | 415V PCC/ PMCC/ MCC | : | 50 kA/1sec |
| (d) | Lighting Distribution Boards & 240V A.C. supply | : | 9 kA/1sec |
| 7.18.7 | Auxiliary DC supply | | |

The auxiliary DC supply will be used for control, indication & protection, Turbine lube oil system, AVR, Emergency DC lighting of power plant and Control & Instrumentation etc.

- | | | | |
|-----|-------------------|---|--|
| (a) | Voltage | : | (i) 220V DC for utility purpose
(ii) 24V DC for Control and Instrumentation |
| (b) | Voltage variation | : | + 10 %, - 15 % |

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7.18.8 Emergency power supply

- (a) Purpose : (i) Standby power to normal incomer of emergency MCC
(ii) Alternate power source to Fire water Pumps

- (b) Rated voltage and frequency : 415 V, 3 phase, 3 wire, 50 Hz.

7.18.9 UPS power supply

- (a) Purpose : (i) Vital process loads
(ii) Critical lighting
(iii) Control and Instrumentation
(iv) Office for LAN power supply/Server etc.

- (b) Rated Voltage : 415V, 3 ph, neutral/240V single phase, 50Hz

7.19 The variation in voltage and frequency may be $\pm 10\%$ and $\pm 5\%$ respectively. The combined voltage and frequency variation may be $\pm 10\%$. All devices shall be suitable for continuous operation over the entire range of voltage variation without any change in their performance

7.20 Power socket shall be 415V AC, 50 Hz, 4 pin 32/63 Amps. Power socket outlets for portable tools, hand lamps etc shall be 240 volts, single phase, 3 pin, metal clad industrial type

7.21 All electrical equipment shall be designed for the following ambient conditions

- (a) Maximum ambient temperature : 50°C
(b) Minimum Ambient temperature : 13°C

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**SECTION-C1
(SPECIFIC TECHNICAL REQUIREMENT-MECHANICAL)**



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1.0 GENERAL

This specification is intended to cover design, engineering, manufacture, fabrication, assembly, inspection & testing at vendor's & sub vendor's works, painting, forwarding, supply and delivery at site including start up and commissioning spares, mandatory spares, operation & maintenance spares, as required, properly packed for transportation, loading/unloading / handling and storage at site, in site transportation, assembly, erection and commissioning, trial run, preparation and submission of drawing/documents including "As Built" drawings, site testing, carrying out performance guarantee tests at site and handover in flawless operating condition to end customer the entire Pre Treatment Plant complete with all accessories including civil design & construction works of Pre Treatment Plant (excluding Chemical house & Centrifuge Shed/Building) for **1X660 MW BHUSAWAL THERMAL POWER STATION, UNIT # 6**.

Civil design & construction works of Pre Treatment Plant (Excluding Chemical house & Centrifuge Shed/Building) shall be in Bidder's scope.

2.0 REFERENCE DOCUMENTS

- A. PE-DG-415-158A-A001 : P & ID FOR PRE TREATMENT PLANT
- B. DATASHEET – A : FOR ABOVE SYSTEM
- C. PE-DG-415-100-M001 : PLOT PLAN
- D. INDICATIVE LAYOUT OF PT PLANT 1x660 MW BHUSAWAL TPS (WITH GRADING LINE DEMARKATION AND DIFFERENT FGL INDICATION)
- E. PE-DG-415-172-N005 : MECHANICAL GA OF CLARIFIED WATER PUMP HOUSE
- F. PE-DG-415-172-N001 : PLANT WATER SYSTEM P&ID
- G. TOPOGRAPHICAL SURVEY
- H. DM PLANT PUMP FOUNDATION BLOCK
- I. OTHER INPUTS FURNISHED IN SPECIFICATION

3.0 SCOPE OF SUPPLY (MECHANICAL & CIVIL AND ALSO REFER SECTION C4 FOR DETAILED SPECIFICATION OF CIVIL)

Bidder to note that Pre-treatment Plant shall include associated Mechanical, Electrical, Control & instrumentation & civil work. All the work i.e. Mechanical, C&I, Electrical & civil works (refer electrical, C&I & civil for respective scope), Broad scope of supply has been listed below :-

- 1) Raw water inlet piping to aerator complete with piping, fitting and valves. The inlet piping is to include motorized butterfly type control valve with manual upstream and downstream isolation valves along with manual by-pass valve with necessary instrumentation.
- 2) One (1) number Cascade Type Aerator of RCC Construction with all accessories.
- 3) One (1) number stilling chamber of RCC Construction of required capacity along with isolation gates at the inlet to the flash mixers.
- 4) Channel from Aerator to Stilling Chamber as per P & ID enclosed for pre-treatment plant.
- 5) Two (2) numbers of parshall flume of RCC for DM and Non-DM with flow measuring element in each channel (with Ultra sonic flow measurement device).
- 6) Two (2) number Flash Mixer for DM and Non-DM with detention time of 1 minute (min) and slow speed agitator with baffles, isolation gates etc. each complete with all accessories. Drainage of flash mixers shall be connected to the sludge sump.
- 7) Two (2) nos. High Recovery Solid Contact Type Clarifiers – 1 no. for DM and 1 no. for Non-DM (over ground as much as possible) each complete with mixer cum solids recirculation device along with drive and drive motor, cone shaped truncated flocculation skirt, rake mechanism along with drive and drive motor, collection troughs, telescopic type continuous sludge discharge arrangement, intermittent timer operated main sludge disposal system and all other accessories with sampling points at different elevation of clarifiers. With respect to water analysis furnished in the specification, PT plant (including clarifiers, thickener, centrifuge, gravity filters etc) shall be designed as per raw water analysis indicated in the specification, however PT plant (including clarifiers,

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thickener, centrifuge, gravity filters etc) should also be capable to operate under lower values of turbidity/TSS with outlet water quality requirement as stipulated in the specification.

- 8) Two (2) Clarifiers bridges assemblies for HRSCC, hand railings, motors with VFD, valves, piping, instrumentation etc. for clarifiers.
- 9) Two (2) nos. Outlet channels of RCC Construction from High Recovery Solid Contact Type Clarifiers up to the Gravity Filter for DM and Non-DM.
- 10) Two (2) nos. (2x100%) of capacity 100 Cum/h each, Twin bed type Gravity Filters for DM each complete with filter media, inlet distribution system, under drainage system, necessary valves, nozzles, rate of flow controller, indicator, loss of head gauge, isolation and all other accessories.
- 11) Nine (9) nos. (8W+1SB) of capacity 250 Cum/h each, Twin bed type Gravity Filters for Non-DM each complete with filter media, inlet distribution system, under drainage system, necessary valves, nozzles, rate of flow controller, indicator, loss of head gauge, isolation and all other accessories.
- 12) Four (4) nos. oil free Gravity Filter air blowers with acoustic enclosure i.e (1W+1S) for DM and (1W+1S) for Non-DM complete with drive motors, suction filter, suction and discharge silencers, relief valves, instruments and all other accessories as required.
- 13) Two (2) no. Filter House for accommodating Gravity Sand Filters.
- 14) Two (2) nos. Overhead Backwash Water Storage Tank for DM and Non-DM on the roof of the Filter House for Gravity Filter Units, complete with integral pipe works, valves and all other accessories as required. Overhead backwash water tank capacity shall be calculated based on water requirement of two back wash cycle individually for DM and NON DM backwash tanks.
- 15) Two (2) nos. independent Flow Control Station for DM and Non-DM at Gravity Filter outlet along with bypass valve and all other accessories.
- 16) One no RCC filter water storage tank with min effective capacity of 900 M3 with RCC covered (totally enclosed) for DM along with Pump house and associated instrumentation like level transmitters alarm indicator and controller
- 17) One (1) no. Common RCC Sludge Sump & pump house for DM and Non-DM (with two compartments) cum Pump House complete with all accessories.
- 18) Two (2) nos. (1W+1S) oil free Air Blowers with acoustic enclosure for air agitation system of the sludge sump with acoustic enclosure, piping, valves, instrumentation etc.
- 19) Two (2) nos. (1W+1S) Sludge Transfer Pumps with piping, valves, fittings and instrumentation up to thickener, and Stilling Chamber.
- 20) One (1) number of RCC Sludge thickener of required capacity, with full bridge, scraper rack, drive mechanism and all other accessories,-associated valves, piping & instrumentation etc.
- 21) One (1) no. RCC thickened waste sump (in twin section) with common sump & pump house interconnected through valves.
- 22) Two (2) nos. (1W+1S) Sludge disposal pumps with piping, valves, fittings and instrumentation up to Centrifuge.
- 23) Two (2) nos. (1W+1S) Air blowers of oil free type with acoustic enclosure of required capacity, its drives and associated accessories, piping, valves, instrumentations for Thickened waste sump for air scouring of sump.
- 24) Two (2) nos. (2x100%), (1W+1S) centrifuge along with Variable frequency drive and solid cake disposal system including associated pipes, chutes, valves and other accessories. Centrifuge shall be housed in first floor of the chemical building.

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- 25) Thickener supernatant shall be transferred to stilling chamber through gravity. If it is not possible to transfer Thickener supernatant to stilling chamber by gravity, pump of suitable capacity with piping, valves, fittings and instrumentation up to Stilling Chamber shall be provided by the bidder.
- 26) One (1) no. Electrically Operated Monorail Hoist of 1.0 Ton safe working capacity for Sludge Sump cum Pump House. Two (2) nos Electrically Operated Monorail Hoist of 1.0 Ton safe working capacity for ground floor and first floor of chemical house. In addition to above, electric hoist of adequate capacity in all P/H and blower house shall be provided as per requirement.
- 27) One (1) nos. RCC Filter back wash storage tank with RCC covered (totally enclosed) having effective capacity, sufficient to store back wash water generated due to two Gravity Filters units of Non-DM back washed simultaneously along with Pump house and associated instrumentation like level transmitters alarm indicator and controller.
- 28) Two (2) nos. Filter back wash transfer pump with piping, valves, fittings and instrumentation up to Stilling Chamber and sludge sump.
- 29) Four nos. (4) Sludge closed dumper trolley for transfer of sludge from centrifuge outlet to disposal area.
- 30) All electrical & Mechanical equipment such as pumps, blowers, centrifuge etc. in Pre-Treatment plant shall be provided with permanent housing arrangement with RCC roof, side cladding, flooring, doors/windows, ventilation arrangement and lifting arrangement (Electric Hoist of adequate capacity and monorails) etc.
- 31) One (1) no. two storey chemical house building to store chemicals for minimum 30 days requirements, tanks, pumps, etc. for both Pretreatment plant. Chemicals shall be unloaded from the trucks and thereafter be stacked in the respective storage space at ground floor by means of an Electrically Operated Monorail Hoist. Preparation of chemical solution of alum and lime for injection to water shall be carried out in the first floor of the Chemical House. Chemicals shall be lifted from ground floor to first floor by means of another Electrically Operated Monorail Hoist. The Civil Design & Construction work of Chemical House & centrifuge building shall be in BHEL scope however Mechanical layout, civil input drawing and electrical layout engineering shall be done by bidder. The chemical tanks (Other than RCC), dosing pumps, transfer pumps, instruments, piping, valves, platforms along with handrails, weighing & handling equipment, ladders, cable trays, piping supports, auxiliary structures for pipe fixing, electric hoist etc. along with all structural steel, inside the chemical house shall be in the scope of bidder.
- 32) Chemical house overhead tank shall be constructed by BHEL. However, the associated piping, valves, instruments etc. as per P&ID shall be in PT plant bidders scope.
- 33) Two (2) nos. Alum Solution Preparation Tanks common for DM and Non-DM each complete with motorized stirrer, flushing arrangement, instrumentation, valves, fittings and piping up to the dosing point.
- 34) Four (4) nos. Alum Solution Dosing Pumps. Two (2) nos. (1W+1SB) for DM and Two (2) nos. (1W+1SB) for Non-DM with Piping, valves & instrumentation etc.
- 35) Two (2) nos. Lime Solution Slaking Tanks common for DM and Non-DM each complete with motorized stirrer, flushing arrangement, instrumentation, valves, fittings and piping up to the Lime Solution Preparation Tank.
- 36) Two (2) nos. Slaked Lime Transfer Pumps Common for DM and Non-DM with Piping, valves & instrumentation etc.
- 37) Two (2) nos. Lime Solution Preparation Tanks common for DM and Non-DM each complete with motorized stirrer, flushing arrangement, instrumentation, valves, fittings with internal and external lining as required and piping up to the dosing point.
- 38) Four (4) nos. Lime Solution Recirculation cum Dosing Pumps. Two (2) nos. (1W+1SB) for DM and Two (2) nos. (1W+1SB) for Non-DM with Piping, valves & instrumentation etc.
- 39) Two (2) nos. Polyelectrolyte Solution Preparation Tanks common for DM and Non-DM each complete with motorized stirrer, flushing arrangement, instrumentation, valves, fittings and piping up to the dosing point.

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- 40) Four (4) nos. Polyelectrolyte Solution Dosing Pumps. Two (2) nos. (1W+1SB) for DM and Two (2) nos. (1W+1SB) for Non-DM with Piping, valves & instrumentation etc.
- 41) Two (2) nos. Weighing Scales 0 to 500 Kg and 0-2000 Kg.
- 42) Ventilation system of buildings (pump house, blower house etc.) other than chemical house shall be in PT plant bidder scope.
- 43) Mandatory spares. .(Refer attached, Annexure-V/Section-C1).
- 44) Start-up and commissioning spares as required.
- 45) All piping, valves, instruments as required for the system completion.
- 46) All motorized valves shall be provided with integral starter.
- 47) Turbidity analyzers at locations as indicated in P&ID.
- 48) Operating platforms shall be provided for all the structures such as aerator, stilling chamber, clarifier, sludge chamber, thickener etc. along with ladders and hand railing.
- 49) All pipes, puddle Pipes, fittings, structural steel etc. required for hand railing, platforms, and ladders shall be in the scope of bidder. All insert plates, nuts and bolts, counter flanges wherever applicable shall be in the scope of bidder.
- 50) Edge angle required in a proper shape for edge protection in civil works will be provided by bidder.
- 51) All sluice gates along with suitable protection shall be in the scope of bidder.
- 52) All auxiliary steel structures (U-clamps, nuts, bolts, channels etc.) for fixing the pipe on the pedestal or trestles shall be in the scope of bidder.
- 53) The Bidder's scope includes all the first fill and six months's topping, requirements of consumables such as oils, lubricants including grease, servo fluids, chemicals & reagents required for analysers and topping of all these consumables during the initial operation, trial run, pre-commissioning & commissioning activities, PG test and final handing over to customer. This additional quantity shall be supplied in separate Containers. As far as possible lubricants marketed by the Indian Oil Corporation shall be used. The variety of lubricants shall be kept to a minimum possible.
- 54) Hydraulics of the Complete Pre-treatment Plant shall be designed to take an occasional over loading of 20% over the design flow.
- 55) Wherever terminal points between BHEL and bidder indicated, bidder shall provide pipes with counter flange.
- 56) One set of all special tools & tackles of reputed make necessary for proper maintenance or adjustment of the equipment being supplied by the bidder, packed in permanent box.
- 57) Sufficient numbers of portable type ladders with platform to be supplied for ease of maintenance.
- 58) Necessary pipe, piping, fitting, valves, drains, vents, sampling etc. required for the complete PT Plant. Pipe racks shall be provided by BHEL wherever available. Wherever pipe racks are not available, pipe shall be laid on pedestal (for civil scope refer Section-C4). However all auxiliary steel structure (U-clamps, nuts, bolts, channels etc.) for fixing pipes on pedestal or racks for complete pre-treatment plant shall be in bidder's scope.
- 59) All the sumps, tanks, reservoirs and other water retaining structures shall be provided with access ladders/ rungs from operating platforms/ ground level as the case may be and de-watering pits one for each section. Hand railing will be provided by bidder for safety purpose in all civil structures. Supply and erection of all Hand railing as desired for safety purpose will be in bidder's scope.
- 60) Supply & Erection of clarifier inlet, outlet and sludge inlet and outlet piping shall be in bidder's scope.
- 61) Charging platform for all the chemical tanks along with required handrails, accessories etc . Permanent ladder (not rungs) for approaching the top of tanks, valves for All steel inserts plates with lugs, plates, bolts, nuts,

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sleeves, edge angles and all other embedding components etc as required to grout in civil works and to support/hold the equipment's for opening/maintenance purpose, shall be in bidder's scope.

- 62) VFD panel shall be provided for Clariflocculator and centrifuge.
- 63) Equipment for jar test shall be provided by bidders for testing of water.
- 64) **Hand Railings and Ladders**-All handrails and ladders shall be galvanised at the rate of 610 Gms / Sq. as per IS : 4736.
- 65) All channels & brackets, mounting plates as required for mounting of motors, pumps, stirrers, tank etc.
- 66) Six (6) sets of safety equipment [(Personal Protection Equipment (PPE)] comprising PVC protection suits with hoods, rubber boots, face visors and thick PVC gauntlets shall also be provided by the bidder. Two (2) number safety shower units and adequate nos. of eye fountains to protect against any chemical hazard shall also be provided by the bidder.
- 67) All other things are also included in scope of supply as specified in other part of the specification including under design criteria and technical details.
- 68) Layout for pre-treatment plant shall be designed in such a way that all units (e.g.- aerator, stilling chamber, , flash mixer, clarifiers, gravity filters, inlet channel, chemical house building etc.) shall be interconnected by at least 1.2 M wide walkway at appropriate elevations with hand-railing on both sides and pathway at ground level.

4.0 PIPING AND VALVE

All the piping as listed below shall be in bidder's scope. The below indicated pipes shall be designed, supplied, erected, laid and tested by the bidder. Elbows, tees, puddle pipes, flanges Hangers and supports, embedment plates with lugs etc required for the below given piping shall also be provided by the bidder.

1. All piping within the Pre-Treatment Plant & as defined in specification.
2. Inlet and outlet pipes for each sumps, pits, pumps, other equipment, etc. with pipe connections to the respective sumps, pits, equipment.
3. Minimum 600 NB of 20 meter Raw water inlet piping to PT plant clarifiers as per Terminal point.
4. Clarified water piping, instrument air piping, service air piping, potable water piping, etc. as applicable as per the Terminal Points.
5. In addition, any additional piping and associated accessories required to complete the system shall be in bidder's scope.
6. Materials of Construction of pipes under various services as envisaged are reproduced below:

Sr. No.	Service	Material
(i)	Raw Water, Clarified Water, Filtered Water, Clariflocculator Sludge, Service Water, Non- corrosive waste water, sewage water, Back wash water	ERW Carbon Steel Pipe to ASTM 53 Gr. B/IS-1239, Part-I heavy grade for pipe size up to 150 mm NB and IS-3589 for 200 mm NB and above.
(ii)	Alum & Polyelectrolyte Solution	Rubber lined ERW Carbon Steel pipe to ASTM 53 Gr. B/IS-1239, Part-I, heavy grade with rubber lining 3.0 mm thick as per IS 4682 Part-I. (Vide Note-1 below).
(iii)	Lime Solution, Lime Slurry	ERW Carbon Steel Pipe to ASTM 53 Gr. B/IS-1239, Part-I heavy grade.

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Sr. No.	Service	Material
(iv)	Sludge pipe from different manholes to Sludge Pit	RCC pipe as per IS-458 Class NP-2.
(v)	a. Hydrochloric acid (at all concentration)	Rubber lined ERW carbon steel pipe to ASTM A53 Gr. B/IS-1239, Part-I, Heavy grade (see Note-3 below)
	b. Sodium hydroxide (at all concentration)	Rubber lined ERW carbon steel pipe to ASTM A53 Gr. B/IS-1239, Part-I, Heavy grade (see Note-3 below)
(vi)	Decationised water, Degassed water and Demineralised water	Rubber lined ERW carbon steel pipe to ASTM A53 Gr. B/IS-1239, Part-I, Heavy grade for sizes up to 150 mm NB and IS-3589 for 200 mm NB and above (see Note-1 below)
(vii)	Neutralized effluent	Rubber lined ERW carbon steel pipe to ASTM A53 Gr. B/IS-1239, Part-I, Heavy grade up to discharge isolation valve (see Note-2 below)
(viii)	Potable Water, Service Air, Instrument Air	Galvanized Steel Pipe to ASTM 53 Gr. B/IS-1239, Part-I, heavy grade.
(ix)	Sampling Pipe	Stainless Steel to ASTM Schedule-10 S.
(x)	Dielectric glass tube	Borosilicate glass (specially for ozone generation) closed at one end.
(xi)	Ozone electrode	SS 316Ti & should comply as per DIN 19627
(xii)	Gas/Cooling ends	SS 316 Ti
(xiii)	Ozone inlet & outlet connection	SS 316 Ti
Notes:		
1.	For small diameter pipe, where rubber lining is not possible, stainless steel pipe instead of rubber lined steel pipe shall be used.	
2.	For Corrosive service, pipeline of size 32 NB and below where SS-304/316 cannot be used, CPVC pipeline shall be provided.	
3.	For small diameter pipe, where rubber lining is difficult, CPVC PN 10 shall be used for hydrochloric acid. Stainless steel pipe instead of rubber lined steel pipe shall be used for other services	

7. For rubber lined pipe, rubber-lining thickness shall not be less than 3 mm. The lining shall conform to IS: 4682 Part-I.

8. Valves

(a) The valve design and testing standard shall be as follows:

	Less than 50 mm size		50 mm size and above	
	Design	Testing	Design	Testing
Gate	API - 602	API - 598	API - 600	API - 598
Globe	BS - 5352	BS - 6755	BS - 1873	BS - 6755

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Check	BS - 5352	BS - 6755	BS - 1868	BS - 6755
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- (b) Gate, Globe and Check valve on galvanized iron pipe shall be as per above.
- (c) On rubber lined pipe (corrosive service), isolation valve shall be Saunder's Diaphragm type (Weir type) with dimension as per BS 5156. The material of construction shall be cast iron body as per IS: 210 FG 260 with inside hard rubber lining (all wetted parts) 3 mm thick as per IS-4682 (hardness 85-90 on shore A) and neoprene diaphragm. The ends shall be flanged as per ANSI B 16.1, 125 class, FF, full-face rubber lined. The testing shall be as per BS 5156 and rubber lining shall be tested as per IS: 4682.
- (d) Check valve in corrosive service shall be flap type cast iron body with all wetted parts fully rubber lined with 3 mm thick hard rubber (hardness 85-90 on shore A). Ends shall be flanged as per ANSI B 16.1, 125 Class, FF, full-face rubber lined.
- (e) All sampling valves and analyzing instrument isolation valves shall be needle type with stainless steel (AISI 316) design. For all other instrument, isolation valves shall be full bore ball valve of SS 316 construction as per API - 6D. The rating for screwed ball valves shall be 800 class and that for flanged ball valve shall be 150 class. The inspection and testing of ball valves shall be as per API - 607.

5.0 SCOPE OF SUPPLY (ELECTRICAL)

Complete electrical as per specification and details indicated in Section C2 (Specific Technical requirement- Electrical).

6.0 SCOPE OF SUPPLY (C&I)

Complete C&I as per specification and details indicated in Section C3 (Specific Technical requirement -C&I).

7.0 SCOPE OF SUPPLY (CIVIL)

Complete Civil as per specification and details indicated in Section C4 (Specific Technical requirement -Civil).

8.0 SCOPE OF SERVICES

The bidder's scope also includes following services for scope under this specification:

- 1) Erection and commissioning, unloading, storage and handling at site.
- 2) Arrangement of all instruments, reagents, monitoring gadgets for monitoring, & lab facilities to carry out, pre-commissioning, trial run, commissioning, Performance guarantee test & till handover.
- 3) Monitoring gadgets, instruments and equipment required for maintenance.
- 4) Complete grouting for equipment, fixing and any concreting inside the vessels and lining.
- 5) All personnel required during maintenance, Commissioning and Performance guarantee test.
- 6) Trial run for requisite period.
- 7) Performance guarantee test.
- 8) Complete analysis, design, and construction, erection of all civil structural & architectural works of complete pretreatment plant area (Excluding Chemical house & Centrifuge Shed/Building).
- 9) Customer's Training for Operation and Maintenance aspects related to PT Plant minimum for one (1) week.
- 10) Painting shall be as specified in "Surface Preparation & Painting" Section -D of this technical specification. Bidder to note that paint shed shall be finalized during detailed engineering as per customer & BHEL requirement and any variation in the painting schedule as finally approved by customer shall be taken care by bidder without any commercial and delivery implication.
- 11) Final touch up paint at site.
- 12) Bidder shall perform the guarantee parameters as per specification requirement to the satisfaction of owner. The



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exact modalities of verifying guarantee for the parameters indicated in the specification shall be finally as agreed with the owner during detailed engineering & mutually agreed.

9. SALIENT DESIGN FEATURES

1. The water analysis to be adopted for the design of Raw Water Pre-Treatment Plant has been furnished in the specification.
2. Design quality of treated water from Raw Water Pre-Treatment Plant as envisaged has been mentioned in the specification.
3. Each Clariflocculator shall be over ground as much as possible so that sludge disposal arrangement becomes under the ground to the minimum extent possible. The total water loss due to sludge blow down shall be limited to maximum 5% of the total inflow to Clariflocculator. The system shall be suitable to handle sludge with 2% consistency. The system at upstream, inlet and flocculation zone of each Clariflocculator need to be designed to handle excess water to make good for water loss for sludge blow off.
4. Sludge blow-off shall be affected by the static head of water in the Clariflocculator.
5. Various chemical preparation and injection systems in the Raw Water Pre -Treatment Plant shall be designed for the dosage rates as follows:

(a)	Ozone	:	1 ppm (BHEL Scope)
(b)	Alum	:	60 ppm
(c)	Lime	:	25 ppm
(d)	Poly-Electrolyte	:	2 ppm

6. All the chemicals to be used in the Raw Water Pre -Treatment Plant shall generally conform to the requirement of technical grade as per relevant IS code.
7. The ground floor of Chemical House shall be used for chemical storage. Storage space needs to accommodate each of the chemicals required, in order to operate 660 MW TPP, for thirty (30) days, on continuous and at full load basis.

The storage space for each chemical shall be separated from other by partition walls. The stack height (if applicable) for each storage space shall not exceed 2.0 m.

8. A minimum of 300 mm freeboard shall be provided in all chemical solution tanks of the Raw Water Treatment Plant.
9. Gravity filters shall be designed for flow rates as specified in Datasheet.

Filter boxes shall be water-tight R.C.C. structure.

Each filter shall be twin section type and unit shall be capable of handling maximum design flow and reducing turbidity to the extent as specified in Datasheet –

Gravity filters: 2x100% & capacity 100 M³/hr. for each DM chain and

Gravity filters: 9 nos.(8W+1S) units & capacity 250 M³/hr for each non DM chain complete with drive motor, suction filters, suction and discharge silencers and relief valve etc.

Backwashing of gravity filter units shall be carried out once in 24 hours with water taken from Overhead Filter Backwash Water Tank located on the roof of Gravity Filter house. Provision for sectional backwash of filter bed shall be provided. Motorized Butterfly valves shall be provided in backwash of the Gravity filters.

The capacity of the overhead filter backwash water tank shall be sufficient to cater backwash requirement of Gravity Filter unit + 20% margin. The tank shall be provided with level indicator, level switches, vent, drain, overflow etc.



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However, total backwash water requirement for each filter shall be on an average limited to 2% of total filtered water produced by each filter between two (2) successive back washings.

The velocity of water during backwashing shall not be less than 35 m/hr, when air scouring is employed.

The filtering medium shall be washed, screened and hydraulically graded sand, having an aggregated depth not less than 1250 mm. Shape, size and quality of filter sand shall satisfy the following requirements –

- (a) Sand shall be of hard and resistant quartz or quartzite and free of clay, fine particles, soft grains and dirt.
- (b) Effective size shall be 0.45 to 0.7 mm.
- (c) Uniformity co-efficient shall 1.3-1.7
- (d) Ignition loss shall not exceed 0.7% by weight.
- (e) Soluble fraction in HCl shall not exceed 5.0% by weight.
- (f) Silica content shall be not less than 99.8%.
- (g) Specific gravity shall be in the range between 2.55 to 2.65.
- (h) Wearing loads shall not exceed 0.3%.

The depth of gravel in the filter bed shall not be less than 450 mm and the depth of sand layer over the gravel shall not be less than 75 cm.

Bed depth of media, mm: 750 for sand and 450 for gravel

The standing depth of water over each gravity filter shall not be less than 2.0 m.

The filtering rate through the sand filter shall not exceed 5.0 m³/hr/m² of filter area even under 20% overloading condition.

The wash water gutters shall be of R.C.C. construction and the gutters shall be spaced such that the horizontal travel of backwash water does not exceed 1.0 M. The gutters must be adequately sized to carry all the backwash water delivered to it with at least 50 mm between the surface of the water flowing in the gutter and the upper edge of the gutter. The bottom of the gutter shall clear the top of the expanded sand by at least 50 mm.

At least 50% free board shall be left over the filtering media to facilitate backwashing. The filter shall be designed to handle an inlet turbidity of 20 NTU with a guaranteed output quality of 2 NTU after filtration even under overloading of filter units by 20%.

Each filter bed outlet shall be provided with rate of flow controller. The rate of flow controller shall have in built slow starting device.

The controller shall consist of a weir venturi section, diaphragm chamber arrangement, valve mechanism and casing counter weighted scale beam group and recover outlet section.

Each filter bed shall be provided with a rate of flow indicator, and a loss of head gauge.

All valves of filters shall be automatically operated and shall be provided with necessary extension spindles and C.I. headstocks for local manual operation of gravity filters from operating platform.

Only valves shall be used for different process of filters. Gates in filter beds shall not be accepted.

All the instruments which are required for the local operation of the filters shall be locally mounted in a panel located on the operating floor of filters.

Blower for air scouring of filter bed : The flow rate of air shall not be less than 50 Nm³ of free air/hr/m² of bed area at a head suitable for efficient air scouring of filter bed. Four (4) 100% capacity blowers (2 Working + 2



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Standby) shall be provided for both Filters. Blowers shall be oil free type and preferably of rotary type, electric motor driven, complete with silencer and filter duct/pipe work, damper etc. The blowers shall meet the requirements of gravity filters.

Suitable sampling point shall be provided at the effluent of both filters and shall be taken to centralized sampling racks for analysis.

A minimum of 500 mm free board shall be provided above the top water level excluding slab thickness of the operating floor.

10. GENERAL DESIGN AND PERFORMANCE REQUIREMENTS

- 1.1 All the Water Treatment Systems described shall be capable of conveying their rated capacities as per pipe sizing criteria specified in various Sections.
- 1.2 Pipe sizes unless specified otherwise shall be selected by the Bidder based on optimization studies.

Only standard pipes size shall be considered.
- 1.3 The total dynamic head (TDH) of all pumps shall be obtained by conducting detailed system resistance calculations. Bidder shall furnish these calculation and system resistance curves superimposed on pump characteristic curves during detailed engineering. However, actual TDH shall be finalized by the bidder and following general guidelines shall be adhered to by the Bidder towards computation of same.
 - 1.3.1 Static head in each pumping system shall generally be obtained by considering the minimum suction level and maximum discharge point elevation. It shall also take into account all the highest levels encountered in the route
 - 1.3.2 Frictional losses in pipes shall be calculated based on pumping capacity as specified in Datasheet-A of PT plant of this volume, assuming $C = 120$ on Hazen and Williams Formula for design purpose. A minimum of ten (10) percent margin shall be considered for determining pump TDH over and above the calculated frictional losses.
- 1.4 Filtered Water Storage Tank for DM shall be adequately designed for effective total capacity minimum 900 m³.
- 1.5 All piping and related accessories shall be designed to withstand a pressure not less than the shut off head of the respective system pumps.

Bidder shall also conduct water hammer analysis of the piping systems in different transient conditions such as closure of valves, tripping of pumps etc. if required. Bidder shall also consider such transient pressure surges in designing of the piping systems as applicable. The procedure and results of water hammer analysis shall be furnished to Purchaser for his information and approval.

Following valves, fittings and appurtenances shall be provided as minimum requirement for each of the pumping systems.
 - 1.5.1 Motorized discharge butterfly valves, quick closing power packed check valve, gate valves/check valves as required for respective pumps.
 - 1.5.2 Anti Vacuum Valve as required.
 - 1.5.3 Air Cushion Valve as required.
 - 1.5.4 Isolating butterfly valves shall be provided at suitable intervals and at suitable locations to isolate a particular section of pipeline for maintenance.
 - 1.5.5 Scour or drain valves of suitable size at suitable locations for adequate drainage of pipelines.
 - 1.5.6 Thrust blocks and expansion joints/loops at suitable locations as applicable.



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- 1.5.7 Pipe supports/racks complete with all accessories, as specified.
- 1.5.8 Any other accessories as required for safe and reliable operation of respective pumping system.
- Bidder shall furnish a write up, adequately substantiating the use of the above appurtenances, as per applicability, in each water transportation system.
- 1.6 Butterfly valve design pressure and opening/closing time shall take into account all effects of water hammering and surge.
- 1.7 All pump houses accommodating vertical wet pit pumps shall be designed in accordance with the following layout criteria as generally specified below:
- 1.7.1 The pump sumps in each respective pump house shall be designed in strict conformance to the recommendations of Hydraulic Institute (USA)/British Hydraulic Research Association/equivalent standards. Dimension of sump shall be substantiated by the Bidder during detailed engineering.
- 1.7.2 The minimum water level of a particular sump shall be guided by the minimum submergence required by the respective pump (s). The highest water level in a sump shall be such as to ensure a minimum clearance of 300 mm below the lowest concreted portion of the floor in the pump house. Under all circumstances, the net positive suction head available shall be sufficiently greater than the net positive suction head required, by each pump.
- 1.7.3 Adequate provision shall be made in each of the pump sumps so as to facilitate insertion of isolation gates as and when required. Gates shall be fabricated of mild steel, shall be of watertight type and shall preferably be of identical size/dimensions to facilitate interchangeability. Sump gates shall generally be accessible by the pump house overhead electric hoist.
- 1.7.4 The respective pump house shall also accommodate the following equipment/facilities, as applicable.
- (a) All auxiliary equipment related to pump sets such as discharge piping complete with valves and specialties, electric motor drives etc.
 - (b) Ventilation system for the pump house, blower house etc. (Ventilation system of chemical house is in BHEL scope).
 - (c) Separate bays for unloading and maintenance.
 - (d) All necessary electrical equipment as specified in detailed specification of electrical.
- 1.8 **CONTROL AND INSTRUMENTATION**
- PI refer details furnished elsewhere in the specification.
- 1.9 **RECOMMENDED VELOCITY CHART FOR PIPE SIZING**

A	Water				
	(i)	Condenser CW	Below 1000 NB	1000-2000 NB	Above 2000 NB
		a. Pump Suction	1.0	1.3	1.5
		b. Pump discharge / distribution	2.4	2.8	3.0
	(ii)	Water-General	Below 200 NB	200-400 NB	400-700 NB
		a. Pump Suction	1.0		
		b. Pump discharge/ distribution	1.8	2.2	2.5
(b)	Fuel Oil				
		Heavy oil (Heated)			
		a. Pump suction	1.0		
		b. Pump discharge/ distribution	1.5-2.0		



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(c)	Gases		
		a. Compressed air	15-25

11. OPERATION AND CONTROL PHILOSOPHY

- DCS based control system (by BHEL) has been envisaged for Pre-Treatment (PT) plant.
- All remote indications from instruments as per P & ID such as raw water flow indicator, integrator, recorder, opening/closing status and percentage positioning indicator for inlet motor operated flow control valve, Level indicating controller for Filtered Water Reservoir etc. shall be monitored through DCS.
- Local Start/Stop push buttons for all pumps shall be provided. But the remote operation (ON/OFF/TRIP) shall be made through Operating Station and the status of all pumps, agitators and drive motors of other equipments shall be displayed and monitored through DCS. Ammeters wherever required shall also be located in Operating Station.
- Further to above, all drive motors shall have the facility of local Start/Stop. Local starting shall be possible through local/remote selector switch to be located in MCC. Tripping of drive motors shall be permissible by local lockable stop irrespective of local/remote selector switch position. All the drives motors and valves shall be connected to DCS and functions as given shall be performed in the DCS.
- Alarm annunciations as per P & ID and trip annunciation of all drives shall be located in Operating Station.
- The drives as categorized below shall be operated only through local start/ stop push buttons:
 - Drives Motors on the Bridge of each Clariflocculator i.e. rake mechanism drive motor and recirculation drive motors.
 - Drives Motors for Sludge Transfer Pumps.
 - Other drive motors for pumps and air blowers
- Suitable arrangement by adjustable timers shall be provided for sludge blow down valve of each Solid Contact Clariflocculator with the provision for manual intervention and adjustment independently.
- Motorized Butterfly valves shall be provided for Gravity Filters. DCS based operation shall be considered for Gravity Filters.
- Alum, Poly-electrolyte and Lime shall be unloaded from Trucks and stored at ground floor of Chemical House.
- For more detail of Control & Instrumentation, please refer detailed specification of C&I.

12. RAW WATER ANALYSIS FOR DESIGN OF PT PLANT

SR. NO.	PARAMETERS	UNITS	VALUES
1.0	pH		8.0 – 8.5
2.0	Temperature	°C	22 - 30
3.0	Conductivity	µS/cm	1300
4.0	Colour	Hazen Units	Not Available
5.0	Odour		Not Available

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6.0	Taste		Not Available
7.0	TDS	ppm	870
8.0	P-Alkalinity as CaCO ₃	ppm	Nil
9.0	M-Alkalinity as CaCO ₃	ppm	400
10.0	T – Alkalinity as CaCO ₃	ppm	400
11.0	Organic Matter as KMnO ₄	ppm	50
12.0	Iron (as Fe)	ppm	1
13.0	Turbidity (NTU)	ppm	Clariflocculator shall be designed considering Turbidity = 2000 NTU. Centrifuge & thickener shall be designed considering Turbidity = 1000 NTU
14.0	CATIONS		
	(a) Ca as CaCO ₃	ppm	295
	(b) Mg as CaCO ₃	ppm	77
	(c) Na as CaCO ₃	ppm	203
	(d) K as CaCO ₃	ppm	10
	Total Cation	ppm	585
15.0	ANIONS		
	(a) HCO ₃ as CaCO ₃	ppm	400
	(b) Chlorides	ppm	149
	(c) SO ₄ as CaCO ₃	ppm	33
	(d) Fluoride as CaCO ₃	ppm	1
	(e) Nitrate as NO ₃	ppm	2
	Total Anion	ppm	585
16.0	Ammonia	ppm	Absent - Traces
17.0	Silica Colloidal (as SiO ₂)	ppm	< 1 (can be present in summer)
18.0	Silica Non - Colloidal (as SiO ₂)	ppm	36
19.0	Free Chlorine	ppm	Nil
20.0	Total Suspended Solids	ppm	Clariflocculator shall be designed considering TSS = 2000 ppm. Centrifuge & thickener shall be designed considering TSS = 1000 ppm.
21.0	Carbonates as CaCO ₃	ppm	Not Available
22.0	Boron	ppm	Less than One(1) ppm
23.0	Oil & Grease	ppm	Nil



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13. TERMINAL POINTS

- 1) PT Plant inlet-As per P&I diagram of Pre Treatment Plant. (Pressure at inlet of control valves shall be in the range of 10 to 15 MWC).
- 2) 25 NB Instrument air supply at 5 to 7 kg/cm² (g) – At 5 meter distance from PT Plant Chemical House. However distribution and piping inside PT Plant area shall be in bidder's scope.
- 3) 25 NB Service air supply at 5 to 7 kg/cm² (g) - At 5 meter distance from PT Plant Chemical House. However distribution and piping inside PT Plant area shall be in bidder's scope.
- 4) Service water connection (100 NB connections) at 5 meter distance from PT Plant Chemical House. Piping inside PT Plant area for mentioned services will be in bidder's scope. Bidder shall fill the backwash water tank located at gravity filter roof.
- 5) Drinking water (or potable water) of 25 NB connections to PT Plant - At 5 meter distance from PT Plant Chemical House. However distribution and piping inside PT Plant area shall be in bidder's scope.
- 6) Potable water pipe to Plant shall be terminated at 5 meter from pump discharge. The pressure at Terminal Point will be 7 Kg/cm² with respect to the elevation FGL.

14. EXCLUSIONS

- 1) Civil Design & Construction work of Chemical House & Centrifuge Shed/building. However civil input drawing for chemical house & centrifuge shed/building shall be part of bidder's scope.
- 2) All chemicals required for water treatment.
- 3) Air conditioning, ventilation & firefighting facilities. However, heat dissipation data for all motors & panels as applicable shall be finished by the bidder during detail engineering for sizing of HVAC equipment.
- 4) Other exclusions are mentioned in the electrical & C&I parts of this specification.

15. QP AND SUB VENDOR APPROVAL

- 1) The quality assurance plan is enclosed as Annexure-I/section-C1. However requirement of detailed QP, inspection checklist, certificate of conformance etc. for each equipment and sub-vendor shall be finalized during detailed engineering stage; decision of BHEL/customer (MAHAGENCO) shall be binding on vendor in this regard. Any changes/additional tests insisted upon by BHEL/customer (MAHAGENCO) during approval of QAP's shall be accepted by bidder without any commercial and delivery implication to BHEL/Customer (MAHAGENCO). Bidder shall submit the quality plans in BHEL format during detailed engineering stage. Bidder to note further that during detailed engineering all the QAP's/check lists etc. shall be submitted to Customer (MAHAGENCO)/BHEL for approval. All inspection & testing etc. shall be carried out accordingly.
- 2) The sub vendor list enclosed as Annexure-II/section-C1 is indicative only and is subject to approval / acceptance by customer ((MAHAGENCO)/consultants of MAHAGENCO. Bidder to propose his sub vendor list with back up documents (experience list, end user certificate as applicable) etc. The same shall subject to BHEL and Customer approval during detailed engineering stage without any technical, commercial & delivery implication to BHEL.

16. PERFORMANCE GUARANTEE TEST

The Performance guarantee test shall be as per Annexure-III/Section-C1.

17. DESIGN CRITERIA AND TECHNICAL DETAILS

In addition to the requirements of Section C & D the following shall also be complied under scope of this specification. The P&ID for Pre Treatment Plant (**Dwg.No.- PE-DG-415-158-A001**) is enclosed herein in this section for bidders compliance.

The material of construction specified in data sheet-A are minimum requirements and material of construction for other components not specified shall be similarly selected by the bidder for intended duty which shall be subject to BHEL / Customer approval during detail engineering without any commercial & delivery implication to BHEL.



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The other technical requirement shall be as per Technical Requirement of water treatment system. Please refer Section-D of this specification.

18. DRAWING/DOCUMENTS REQUIREMENT

For the Drawings/Documents Requirement & Distribution submission schedule, please refer **Annexure-IV/Section-C1 and General Technical Requirement**.

The bidder has to submit the revised drawing/document along with the compliance sheet indicating enumerate reply to all BHEL and customer comments or observations. Without compliance sheet the submission of the drawings/documents will not be considered and the delay on this account will be solely on bidder's side only. Bidder to comply with the observations of the BHEL and CUSTOMER without price & delivery implication.

19. ADDITIONAL REQUIREMENT

- Engineering for this project is to be carried out in Integrated Intelligent Engineering environment at BHEL end. For Details Refer Drawings/Documents Requirement & Distribution submission schedule
- Initial charge of all lubricants & grease.
- All special tools necessary for proper maintenance or adjustment of the equipment packaged in permanent box. Finish paints for touch-up painting of equipment after erection at site in sealed container.
- Wherever pipe racks are not available, pipes shall run on pedestals or below ground. All fixing items such as U clamps, nuts, bolts etc. required to lay the pipes on pedestals shall be in bidder's scope of work. Coating, wrapping and protection required for buried pipes shall be in bidder's scope of work.
- Wherever pipes are running on pipe rack, Bidder will consider 12 m static head + 10% margin, in addition to the losses in straight length and bend in pipes and valves etc. while selection of pump head during detailed engineering.
- The pumps shall be designed to operate under discharge valve open and close condition.
- Pump suction valves, re-circulation valves and discharge valves shall be provided with required limit switches for interlock & control.
- The starting of pumps (wherever applicable) which are provided with forced water lubrication shall be interlocked with the availability of lube water by means of starting of lubrication water pumps, availability of adequate flow, pressure etc. The standby lubrication pump shall be started automatically during inadequate pressure or while tripping of working pump(s). Pumps required for lubrication shall be in bidder's scope.
- All the first fill and one Year's topping requirements or 10 % of first fill quantity, whichever is more of consumable such as greases, oil, lubricants, servo fluids/control fluids, gases and etc. which will be required to put the equipment covered under the scope of specifications, into successful commissioning / initial operation and to establish completion of facilities shall be furnished by the bidder. Suitable standard lubricants as available in India are desired. Efforts should be made to limit the variety of lubricants to minimum.
- Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.
- In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.
- Bidders shall make Site visit in order to familiarize themselves with existing condition of site before submitting the bid in order to make their offer complete. During detail engineering also, the successful bidder shall be responsible for the correctness of details w.r.t. existing facility at site. Customer approval on any drawing having details of existing facility shall not be cited by the successful bidder a valid reason for any shortcoming in the work

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by them. BHEL shall also not entertain any cost implication for any lack of input data with regard to site during detail engineering.

13. Final Electrical Load list will be submitted by the successful bidder as per agreed drawing/ doc submission schedule. Thereafter any change in the electrical load list shall be entertained only subject to its feasibility, and BHEL reserves the right to debit the vendor cost of any changes necessitated in the switch gear /MCC on account of changed loads.
14. The complete system shall be proven and necessary design documentation in support of proveness shall be submitted by the successful bidder in support of the systems, if asked by the customer without any price and delivery implication to BHEL and customer.
15. Wherever CIVIL works is excluded from the bidder's scope, successful bidder shall furnish civil assignment / scope drawings. The corresponding CIVIL drawing prepared by BHEL / CIVIL agency, based on civil assignment drawing of bidder will be furnished to the site for construction. In case any modification is required in the civil work already carried out based on final civil inputs given by vendor, BHEL reserves the right to debit cost of such rework to vendor".
16. System to be designed to meet all the statutory requirements. Preparation of all necessary drawings/data/ documents for obtaining necessary Approval of statutory authorities like CCOE , IBR , Weight & Measures Department and any other agency/ competent authority ,on behalf of the customer, related to installation of DM plant (if required) is included in bidder's scope. All expenses required to obtain the approval shall also be borne by the successful bidder. Successful bidder shall inform customer well in advance requirement of authority letter along with format for the same. After issuance of authority letter by customer, it will be vendor's responsibility to regularly follow up with the concerned authorities to obtain timely approval from these authorities. Any delay on account of the same, unless any specific information related to above approval to be furnished by customer is delayed by customer, shall be to vendor's account and shall not be used as a reason for extension in contract completion.
17. Vendor to attend regular engineering meeting with BHEL and customer fortnightly in BHEL or customer office as decided during detail engineering. Vendor will depute all his concerned engineering representative along with the project manager for discussion and approval. Meeting can be held at site also.
18. Space available for PT Plant is attached, elsewhere in this specification. Bidder to generally accommodate their equipment within the space provided.
19. Bidder to submit BBU during detailed engineering after approval of Basic documents. Incomplete BBU shall not be reviewed by BHEL.
20. Preparation of drawings / document / P&ID's in 3D modelling software and providing soft copy of same to BHEL.
21. Preparation of e-learning package/module and providing the same to BHEL & MAHAGENCO for the complete pre-treatment plant. The necessary requirement shall be as per detail specified elsewhere in this specification.
22. Training of plant Owner's personnel, O&M operators' personnel on plant operation and maintenance.
23. Relevant requirements as per GTR, GCC, ECC & SCC.
24. Any statutory requirement / clearance required for the packages from government / local body shall be in bidder's scope. Any change arising out of any new government norms, statutory requirements during the course of execution of the project shall also be complied by the bidder without any commercial implication.
25. Instrument, valves, & piping shown in the P&IDs are bare minimum requirement. Any additional instrument, valves, and piping required as per system requirement, shall be in the bidders scope.
26. Wherever gravity flow is not possible the bidder shall provide suitable storage & pumping system (2x100%) along with Piping, valves & instrumentation etc to meet the system & process requirement.
27. Service water shall be available near to pretreatment plant/ system building/ area at approximately 1.5 to 2.0 Kg/ Cm2. Hence, bidder to take care for cooling/ lubrication of the pumps being supplied by the bidder under this



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technical specification. If service water pressure requirement is more than available pressure, bidder to consider two (2) nos. cooling pump/lubrication pump for pre-treatment plant.

28. Capacity of monorail hoists, chain pulley block wherever indicated in Datasheet– A are minimum and capacity of such hoists, chain pulley block etc. shall be suitable for handling 125% of maximum weight to be handled during erection and maintenance of the equipments in the pump house, buildings etc. as the case may be.
29. Wherever local instruments for measurement of Flow, Pressure, Level is indicated in the P&ID, Bidder to provide Diaphragm seal type instrument for Chemical (all type and concentration), corrosive, viscous fluids application.
30. Charging platform for all the chemical tanks along with required handrails, accessories etc . Permanent ladder (not rungs) for approaching the top of tanks, valves for All steel inserts plates with lugs, plates, bolts, nuts, sleeves, edge angles and all other embedding components etc as required to grout in civil works and to support/hold the equipment's for opening/maintenance purpose, shall be in bidder's scope.
31. Slings & Lifting lugs shall be provided in all equipment.
32. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.
33. Latest version of all codes and standards to be followed.

20. SITE VISIT BEFORE SUBMISSION OF OFFER.

Bidders shall make Site visit in order to familiarize themselves with existing condition of site before submitting the bid in order to make their offer complete. During detail engineering also, the successful bidder shall be responsible for the correctness of details w.r.t existing facility at site. Customer approval on any drawing having details of existing facility shall not be cited by the successful bidder a valid reason for any shortcoming in the work by them. BHEL shall also not entertain any cost implication for any lack of input data with regard to site during detail engineering.

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1.0 QUALITY ASSURANCE PROGRAMME

- 1.1 To ensure that the equipment and services under the scope of Contract whether manufactured or performed within the Contractor's works or at his Sub-contractor's premises or at the Owner's site or at any other place or work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Owner/Authorised representative after discussions before the award of contract. A quality assurance programme of the Contractor shall generally cover the following:
- 1.1.1 His organisation structure for the management and implementation of the proposed quality assurance programme.
 - 1.1.2 Documentation control system.
 - 1.1.3 Qualification data for Bidder's key personnel.
 - 1.1.4 The procedure for purchase of materials, parts, components and selection of Sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.
 - 1.1.5 System for shop manufacturing and site erection control including process controls and fabrication and assembly controls.
 - 1.1.6 Control of non-conforming items and system for corrective actions.
 - 1.1.7 Inspection and test procedure both for manufacture and all site related works.
 - 1.1.8 Control of calibration and testing of measuring and testing equipments.
 - 1.1.9 System for quality audit.
 - 1.1.10 System for indication and appraisal of inspection status.
 - 1.1.11 System for authorising of release of manufactured product to the Owner.
 - 1.1.12 System for handling storage and delivery.
 - 1.1.13 System for maintenance of records.
 - 1.1.14 Furnishing of quality plans for manufacturing and field activities, detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component.

2.0 GENERAL REQUIREMENTS - QUALITY ASSURANCE

- 2.1 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection /tests to be carried out by the Contractor for some of the major items is given in the respective technical specification. This is however, not intended to form a comprehensive programme as it is the Contractor's responsibility to draw up and implement such programme duly approved by the Owner/Consultant. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder, separately in the format attached at Annexures and shall be submitted to Owner/ Authorised representative for approval. Schedule of finalisation of such quality plans will be finalised before award.
- 2.2 Manufacturing Quality Plan shall detail out for all the components and equipment, various tests/inspection to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's Quality Control organisation, the relevant

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reference documents and standards, acceptance norms, inspection documents raised etc, during all stages of materials procurement, manufacture, assembly and final testing/performance testing.

- 2.3 Field Quality Plans shall detail out for all the equipment, the quality practices and procedures etc to be followed by the Contractor's site Quality Control organisation, during various stages of site activities from receipt of materials/equipment at site.
- 2.4 The Bidder shall also furnish copies of the reference documents / plant standards / acceptance norms/tests and inspection procedure etc. as referred in Quality Plans along with Quality Plans. These Quality plans and reference documents/standards etc. shall be subject to Owner's approval without which manufacture shall not proceed. These approved documents shall form a part of the contract. In these approved quality plans, Owner/Authorised representative shall identify Customer Hold Points (CHP), test/ checks which shall be carried out in presence of the Owner's Engineer or his authorised representative and beyond which the work will not proceed without consent of Owner/Authorised representative in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Owner/Authorised representative for approval and disposal.
- 2.5 Dispatch Clearance:
- 2.5.1 On completion of tests of equipment at manufacturer's works, the Contractor shall furnish 4 copies of test certificate(s) as required as per the approved quality plan to the Controller of Quality for approval under intimation to the Project Manager. The test report shall invariably indicate identification data, including Model No., Sr. No. etc. of the equipment, method of application and duration of test along with test results.
- 2.5.2 For the purpose of transmission of the test reports and speedy approvals, the owner may utilise the provision of the c-Folders module of ERP system being operated by the owner. The contractor shall have access to the respective folder of the system to enable him to upload/transmit the soft copies of inspection report (in*.pdf form). Decision in this regard shall be taken during the execution of the contract by mutual agreement. However, the report in physical form shall also be invariably submitted.
- 2.5.3 Only on approval of these test results by the Controller of Quality and the despatch clearance thereafter by the Project Manager, the material shall be despatched to site. The despatch clearance shall be notified by way of e-mail/fax/letters as may be mutually agreed during execution of the contract.
- 2.6 All materials used or supplied shall be accompanied by valid and approved materials certificates and tests and inspection report. These certificates and reports shall indicate the sheet numbers or other such acceptable identification numbers of the material. The material certified shall also have the identification details stamped on it.
- 2.7 Castings and forgings used for construction shall be of tested quality. Details of results of chemical analysis, heat treatment record and mechanical property test results shall be furnished.
- 2.8 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section-IX/BS-4870 or other International equivalent standard acceptable to the Owner.
- All brazers, welders etc. employed on any part of the contract at Contractor's / Sub-Contractor's works or at site shall be qualified as per ASME Section-IX or BS- 4871 or equivalent international standard approved by the Owner. Such qualification tests shall be conducted in presence of Owner/his authorised representative.
- For welding of pressure parts and high pressure piping, the requirements of IBR shall also be complied with.
- 2.9 All Non-Destructive Tests (NDT) shall be carried out in accordance with approved International Standard. The NDT operator shall be qualified as per SNT-TC-IA (of American Society of non- destructive examination)/EN/Equivalent. Results of NDT shall be properly recorded and submitted for approval.

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- 2.10 List of all the sub-vendors proposed by the Contractor for procurement of major bought out items including castings, forgings, semi-finished and finished components/ equipment shall be drawn up by the Contractor and finalised with the Owner. Such list shall be subject to Owner's approval. Quality Plans of the successful vendors shall be discussed, finalised and approved by the Owner/Authorised representative and form part of the Purchase Order between the Contractor and the Vendor.
- 2.11 All the purchase specifications for the major bought-out items, list of which shall be drawn up by the Contractor and finalised with the Owner shall be furnished to the Owner for comments and subsequent approval before orders are placed.
- Owner reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-vendor's quality management and control activities. The Contractor shall provide all necessary assistance to enable the Owner carry out such audit and surveillance.
- Quality audit/approval of the results of tests and inspection will not prejudice the right of the Owner to reject equipment not giving the desired performance after erection and shall not in no way limit the liabilities and responsibilities of the Contractor in earning satisfactory performance of equipment as per specification.
- 2.12 Quality requirements for main equipment shall equally apply for spares and replacement items.
- 2.13 Repair/rectification procedures to be adopted to make any job acceptable shall be subject to the approval of the Owner.
- 2.14 For quality assurance of all civil works refer to the specifications for civil works.

3.0 QUALITY ASSURANCE DOCUMENTS

- 3.1 The Contractor shall be required to submit two (2) copies and two (2) sets of softcopies in the form of CD of the following Quality Assurance documents within three (3) weeks after despatch of the equipment:
- 3.1.1 Material mill test reports on components as specified by the specification.
- 3.1.2 The inspection plan with verification, inspection plan checks points, verification sketches, if used and methods used to verify that the inspection and testing points in the inspection plan were performed satisfactorily.
- 3.1.3 Non-destructive examination results/reports including radiography interpretation reports.
- 3.1.4 Factory tests results for testing required as per applicable codes and standards referred in the specification.
- 3.1.5 Welder identification list incorporating welder's and welding operator's qualification procedure and welding identification symbols.
- 3.1.6 Sketches and drawings used for indicating the method of traceability of the radiographs to the location on the equipment.
- 3.1.7 Stress relief time temperature charts.
- 3.1.8 Inspection reports duly signed by QA personnel of the Owner and Contractor for the agreed inspection hold points. During the course of inspection, the following shall also be recorded:
- (a) When some important repair work is involved to make the job acceptable.
- (b) The repair work remains part of the accepted product quality.
- 3.2 Letter of conformity certifying that the requirement is in compliance with finalised specification requirements.

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4.0 INSPECTION, TESTING AND INSPECTION CERTIFICATES

- 4.1 The Engineer, his duly authorised representative and/or an outside inspection agency acting on behalf of the Owner shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Engineer and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.
- 4.2 Stage Inspection/Pre-Dispatch Inspection by the Owner/his Authorised Representative
- 4.2.1 The inspection of goods to be supplied by the owner's authorised representative shall be generally carried out as stipulated hereunder at pre-identified customer hold points as per the approved Quality Plan. However, the owner or his authorised representative shall have unrestricted access to the premises of contractor/subcontractor where goods to be supplied against this contract are manufacture during the process of manufacturing of goods.
- 4.2.2 The authorised representative of the owner/Independent Inspection Agency (IIA) appointed by the owner shall carry out inspection at customer hold points. All the costs of deputing owner's representative/IIA of such inspection shall be borne by the owner.
- 4.2.3 The contractor, at-least one month prior to expected date of attaining the respective stage of manufacturing/readiness of the goods, shall submit the inspection call indicating the date of inspection to the Controller of the Quality appointed by the owner/IIA under intimation to the Controller of Quality.
- 4.2.4 The Controller of the Quality appointed by the owner/IIA, within fifteen days from the date of receipt of such notice, shall intimate the contractor, the probable date of visit for the inspection. Such date in any case shall not be later than eight days from the date of inspection as intimated by the contractor.
- 4.2.5 The inspection shall be carried out by the authorised representative of the owner/Independent Inspection Agency (IIA) strictly as per the approved quality plan. However, in the event of owner grants waiver for such inspection or the owner's representative/IIA is not able to attend the inspection on the date confirmed as per Clause No. 4.2.4 above, the contractor shall carryout the inspection as per the approved Quality Plan and submit the report of the same to the Controller of the Quality.
- 4.2.6 In the event the inspection is not be carried out on the date confirmed as per Clause No. 4.2.4 above and inspection call is required to be cancelled, all the costs of deputing owner's representative/IIA shall be recovered from the contractor's invoices.
- 4.3 In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Engineer/ Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Engineer/ Inspector or to his authorised representative to accomplish testing.
- 4.4 To facilitate advance planning of inspection in addition to giving inspection notice, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at customer hold point and final inspection stages. Updated quarterly inspection plans shall be made for each three consecutive months and shall be furnished before beginning of each calendar month.

5.0 INSPECTION AND TESTING FOR RAW WATER TREATMENT PLANT

5.1 GENERAL

The testing and inspections listed herein are the minimum requirements as perceived by the Owner; the bidder shall consider this only as a general guidance and is not meant to be exhaustive. The bidder shall consider requisite testing and inspections across the equipments/systems forming the proposed

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power plant unit based on his own experience and in line with the current industry practices for identically rated power plant for the technology under consideration and relevant codes and standards. The comprehensive list of tests considered for each of the equipment/systems shall be furnished as part of the bid.

5.2 TESTS AT MANUFACTURER'S WORKS

Shop tests shall include all tests to be carried out at Bidder's works, works of their sub-vendors and at works where raw materials to be used for fabrication of equipment are manufactured. The tests to be carried out shall include but not be limited to the following:

- (a) Composition of all material, castings, forgings etc.
- (b) Hydraulic tests for pressure vessels, pipes, valves, pump casing etc.
- (c) Tests to check faults in rubber lining [as per IS-4682 (Part-I) or its equivalent] and painting. Static balancing tests on agitators, stirrers, paddles, etc.
- (d) Static and dynamic balancing tests on all impellers.
- (e) Performance tests (Head, Capacity and Power) for each of pumps and blowers.
- (f) Tests of all electrical equipment/accessories as specified in respective electrical sub-sections.
- (g) Control Systems are to be checked for dimensions, wiring continuity, insulation, tubing leakage etc.
- (h) All instruments and accessories are to be checked for performance, over range protection etc as per I.S.A. or other relevant standards.
- (i) Calibration tests of all standard orifices, nozzles, pressure & other instruments.
- (j) Control valves are to be tested for body/seat/diaphragm leakage, lift characteristics and material compositions of body, seat & bonnet.
- (k) Functional tests of the control system.
- (l) Load tests for monorail hoists.
- (m) Calibration tests for Weigh Machine/Load Indicator.

5.3 TESTS AT SITE BEFORE TRIAL RUN

Bidder shall carry out tests at site to prove to the Purchaser that each equipment of the plant complies with the requirements stipulated and is erected in accordance with requirements. Before the plant is put on trial run, the Bidder shall be required to conduct tests to demonstrate to the Purchaser that each item of the plant is capable of correctly performing the functions for which it was specified to. These tests may be conducted concurrently with those required under commissioning sequence. Tests required shall in general be as follows:

- 5.3.1 All piping and valves, after installation, shall be tested hydrostatically at a pressure, one and half times of the maximum attainable pressure in the system, to check against leak tightness.
- 5.3.2 All valves/gates (Manual/Automatic/Remotely Operated) shall be operated throughout 100% of the travel and these should function without any trouble whatsoever.
- 5.3.3 All pumps shall be run with the specified fluid from shut off conditions to valve wide-open condition. Head developed shall be checked from the discharge pressure gauge reading. Capacity may be checked from flow indicators where applicable. If flow indicators are not available in the system, capacity can be checked from the volume of fluid handled (determined from level indicator reading of concerned tank) and duration of test.

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During the test, the pumps and drive motors shall run smoothly without any undue vibration, leakage through gland, temperature rise in the bearing parts, noise, flow pulsation etc.

- (a) Pumps, blowers etc. shall be tested at site to run smoothly without undue vibration, flow pulsation, temperature rise in bearing parts, noise etc.
- (b) The tests to be carried out for the fabricated storage vessels shall include:
 - (i) During fabrication and before lining:
 - a. Bottom testing for leakage by soap solution, after the bottom and at least the bottom course of the shell plate have been welded.
 - b. Hydraulic shell testing for leakage.
 - c. Fixed roof test for leakage by soap solution.
 - (ii) After rubber lining:
 - a. Water leakage test for storage tank by filling it with water up to the overflow level.
- (c) All the rubber lining shall be subjected to the following tests as per IS: 4682 (Part-I).
 - (i) Adhesion test
 - (ii) Resistance to bleeding
 - (iii) Thickness measurement
 - (iv) Shore hardness
 - (v) High voltage spark test
- (d) Epoxy painting shall be checked by dry type thickness gauge.
- (e) Visual check on all structural components, welding, rubber lining, painting etc. and if doubt arises these shall be tested again.
- (f) All testing and calibrating instruments and equipment shall be arranged by the Bidder free of cost to the satisfaction of the Purchaser.
- (g) All monorail hoists shall be subjected to full working load during all motions without showing any sign of defect.
- (h) All the rotating/moving components shall be run at the rated speed with water/chemicals up to the normal water level for a period of twenty-four (24) hours. During this period all the components shall function smoothly without any unbalance, vibration, overheating at bearing parts etc.
- (i) Checks on electrical items as mentioned under electrical specifications.

NOTE:- 1) The above mentioned requirement are bare minimum. However, any additional comments provided by BHEL / Customer shall be adhered by successful bidder without any commercial and delivery implication to BHEL/Customer.

2) For electrical and C&I items testing procedure and QAP mentioned in respective specification shall be applicable/referred.



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TECHNICAL SPECIFICATION FOR
PRE TREATMENT PLANT (PT PLANT)
1X660 MW BHUSAWAL TPS, UNIT # 6

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REV. NO. 00

DATE:

ANNEXURE – I

Test/Check Items / Components	Material Test	WPS/PQR/Welder	DPT/MPI	Assembly Fit up	Dimension	RT	Hydraulic test / Pneumatic test / Vacuum test	Performance Test	Test as per relevant Std / Appd. Data Sheets	Other Tests	Remarks

COMMON ITEMS:										LEGENDS: Applicable tests are identified by 'Y'. Y ^a : One per Heat / Heat Treatment batch / Lot. Y ^b : On machined surfaces only. Also 100% on Butt Welds & 10% on Fillet Welds. Y ^c : UT shall be done for shafts with Dia 50 mm or above & Plates of Thickness 25 mm or above. Y ^d :Dynamic Balancing per ISO: 1940, Grade 6.3 minimum shall be conducted for rotating assy. Y ¹ : As per Pump governing standard. Tolerences as per HIS, USA. Y ² :Random 10% RT to be conducted on butt welds for Thk ≥10 mm. Y ³ : Seat Leakage Test for actuator operated valves shall be done by operating the valve with job actuator. Y ⁴ : Tests on Rubber Diaphragms shall be conducted per batch of Rubber mix for Tensile, Elongation, Hardness, Thickness, Bleed Resistance. In addition, Type Test for 50,000 cycles for each type of diaphragm shall also be conducted.
1. Horizontal Centrifugal Pumps										
1.1. Casing	Y ^a		Y ^b		Y		Y ¹	Y		
1.2. Impeller	Y ^a		Y ^b		Y				Y ^d	
1.3. Shaft	Y ^a		Y		Y				Y ^c	
2. Vertical Pumps										
2.1. Casing	Y ^a		Y ^b		Y		Y ¹	Y		
2.2. Impeller	Y ^a		Y ^b		Y				Y ^d	
2.3. Shaft	Y ^a		Y		Y				Y ^c	
2.4. Fabricated Parts	Y ^a	Y	Y ^b		Y	Y ²	Y			
3. Dosing/ Metering Pumps										
4. Gate/ Globe/ Check Valves										
5. Dual Plate Check Valves										
6. Diaphragm Valves										
7. Butterfly Valves (Low Pr.)										

7.1 Body & Disc (Cast	Y ^a		Y ^b		Y							Y⁶ : Blue Matching, Wear Travel for Gate Valves and reduced pressure test for check valves shall be conducted as per relevant standards. Y⁷ : Heat Treatment of the Tank/Vessel shall be done per fabrication code requirement. Welded dished ends shall be stress relieved. Dished ends manufactured by cold working shall also be stress relieved as per the requirement of code. Y⁸ : RT as per fabrication code requirements. However, dished ends welds, if manufactured by using welded plates shall be subjected to 100% RT. Y⁹ : Rubber Lining Mix shall be subjected to Bleed Resistance Test on mould sample. Adhesion Test, Spark Test and Hardness Test for the Rubber lined jobs shall also be conducted. Y¹⁰ : Gear Boxes shall be checked for smooth No Load Operation at shop to verify noise and vibration levels. Gear Ratio and Kerosene Leak Test shall also be conducted. Y¹¹ : One Fan of each type & size shall be routine performance tested as per corresponding code for air flow, static pressure, total pressure, speed, efficiency, power consumption, noise & temperature rise. Also all Fans shall be subjected to run test of 4 hours during which noise, vibration, temperature rise and current drawn shall be measured. Y¹² : Dry cycle test on valve spring for 1, 00,000 cycles shall be carried out as type test, if not carried out earlier, for the similar MOC, size and type of spring. Y¹³ : Test as per approved supplier practice. Y¹⁴ : Electronic leak test for condenser & evaporator unit. Note: The complete Piping system along with valves & fittings shall be hydraulically tested at 1.5 times design pressure or 2 times working pressure whichever is higher after erection at site.
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Test/Check Items / Components	Material Test	WPS/PQR/Welder	DPT/MPI	Assembly Fit up	Dimension	RT	Hydraulic test / Pneumatic test / Vacuum test	Performance Test	Test as per relevant Std / Appd. Data Sheets	Other Tests	Remarks
7.2 Body and Disc (Fabricated)	Y ^a	Y	Y ^b		Y				Y	Y ²	
7.3 Shaft	Y ^a		Y ^b		Y					Y ^c	
8. Plug/ Ball Valves (Low Pr.)	Y ^a		Y ^b	Y	Y		Y	Y	Y	Y ³	
9. Blowers/ Compressors	Y ^a		Y ^b	Y	Y			Y	Y	Y ^c , Y ^d	
10. Tanks/ Pressure Vessels	Y ^a	Y	Y ^b	Y	Y	Y ⁸	Y		Y	Y ⁷	
11. Rubber Lining	Y ^a				Y				Y	Y ⁹	
12. Strainers	Y ^a	Y	Y ^b	Y	Y		Y		Y		
13. Pipe & Pipe Fittings	Y ^a	Y	Y		Y	Y ⁸	Y		Y		
14. Agitators /Flash Mixer/ Flocculator	Y ^a	Y	Y ^b	Y	Y			Y		Y ¹⁰	
15. Ventilation/Exhaust Fan	Y ^a		Y ^b	Y	Y			Y ¹ ₁	Y	Y ^c , Y ^d	
16. Hoists & Cranes	Y ^a	Y	Y ^b	Y	Y	Y ⁸		Y	Y		
17. Wrapping & Coatig Material	Y				Y				Y		
18. Package/ Split AC	Y							Y	Y	Y ¹⁴	



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Test/Check Items / Components	Material Test	WPS/PQR/Welder	DPT/MPI	Assembly Fit up	Dimension	RT	Hydraulic test / Pneumatic test / Vacuum test	Performance Test	Test as per relevant Std / Appd. Data Sheets	Other Tests	Remarks
PT & LET PLANT:											
1. Clariflocculator / Reactor Clarifier / Plate or Tube Settler	Y ^a	Y	Y ^b	Y	Y				Y	Y ¹⁰	
2. Chlorine Tonner / Chlorine Evaporator	Y ^a	Y	Y ^b	Y	Y	Y ^c	Y		Y		
3. Chlorinator / Ejector	Y ^a			Y	Y		Y	Y	Y		
4. Chlorine Gas Filter	Y ^a			Y	Y		Y		Y		
5. Pressure / Vacuum Relief valve / Pressure Regulating Valve	Y ^a			Y	Y		Y	Y	Y		
DM PLANT & CWT SYSTEM:											
1. Resins / Activated Carbon									Y		
2. Filter Membrane					Y				Y		
3. RO Pressure tube	Y ^a				Y		Y		Y		
CPU SYSTEM:											
1. Butterfly valves / Ball valves (HP)	Y ^a			Y	Y		Y	Y	Y	Y ³	
2. Resins / Activated Carbon									Y		

1) The above mentioned requirement are bare minimum. However any additional comments provided by BHEL / Customer shall be adhered by successful bidder without any commercial and delivery implication to BHEL/Customer.

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ANNEXURE-II**SUB-VENDOR LIST**



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1.0 LIST OF APPROVED VENDORS – MECHANICAL

<u>SR. NO.</u>	<u>ITEM</u>	<u>VENDORS</u>
1.0	<u>WATER TREATMENT PLANT EQUIPMENT</u>	
2.0	VERTICAL TURBINE PUMPS	(a) KIRLOSKAR BROTHERS LTD. (KBL)
		(b) MATHER & PLATT
		(c) WPIL
		(d) JYOTI PUMPS
		(e) FLOWMORE
		(f) SAM
3.0	HORIZONTAL CENTRIFUGAL PUMPS	(a) KBL
		(b) KSB PUMPS
		(c) MATHER & PLATT
		(d) SAM TURBO
		(e) WPIL
		(f) JYOTI PUMPS
		(g) FLOWMORE
		(h) SULZER
		(i) KISHOR PUMPS
4.0	METERING/DOSING PUMPS	(a) MILTON ROY INDIA (P) LTD.
		(b) V.K. PUMPS
		(c) SHAPO TOOLS
5.0	SUMP PUMP	(a) KIRLOSKAR BROTHERS LTD. (KBL)
		(b) SAM
		(c) KISHOR PUMPS
		(d) FLOW MORE
		(e) KSB
		(f) VARTAK PUMPS
		(g) MAXFLOW
6.0	AIR BLOWER (LOBE TYPE)	(a) EVEREST TRANSMISSION
		(b) KAY ENGG. WORKS
		(c) SWAM PNEUMATICS



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<u>SR. NO.</u>	<u>ITEM</u>		<u>VENDORS</u>
		(d)	ROOTS
7.0	BUTTERFLY VALVES (MANUAL/PNEUMATIC)	(a)	KIRLOSKAR BROTHERS LTD.
		(b)	FOURESS
		(c)	L & T
		(d)	INTERVALVE (INDIA) LTD
		(e)	R&D MULTIPLES
		(f)	AUDCO
		(g)	INSTRUMENTATION LTD
		(h)	HAWA VALVES
		(i)	VENUS PUMPS & ENGINEERING WORKS
		(j)	BHEL
		(k)	FLOW VEL
		(l)	LEADER VALVES
8.0	STRAINERS	(a)	SPIRAX MARSHALL
		(b)	MICON VALVES (I) PVT. LTD.
		(c)	FLOWTECH ENGINEERS
		(d)	FOURESS LTD.
		(e)	KSB LTD.
		(f)	L & T
		(g)	LEADER
		(h)	PROCEDYNE ENGINEERS
9.0	CAST IRON VALVE (GATE /GLOBE/CHECK/AIR RELEASE VALVE)	(a)	LEADER VALVE
		(b)	VENUS PUMP
		(c)	FOURESS
		(d)	LEVCON
		(e)	DURGA ENGG CO.
		(f)	L & T
		(g)	R & D MULTIPLES
		(h)	FLUIDLINE VALVES CO PVT LTD
		(i)	INTER VALVE (INDIA) LTD



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<u>SR. NO.</u>	<u>ITEM</u>		<u>VENDORS</u>
		(j)	NSSL LIMITED
10.0	CAST STEEL VALVES (GATE/GLOBE/CHECK/ BALL VALVE)	(a)	L & T
		(b)	KIRLOSKAR BROS. LTD
		(c)	CRESENT VALVES
		(d)	AUDCO
		(e)	KSB
		(f)	LEVCON
		(g)	FOURESS
		(h)	R & D MULTIPLES
		(i)	FLUIDLINE VALVES
		(j)	NSSL LIMITED
		(k)	VENUS PUMP
		(l)	DURGA ENGG CO.
		(m)	HAWA VALVES
		(n)	A.V.VALVES
11.0	STAINLESS STEEL (GATE/GLOBE/CHECK VALVE)	(a)	CRESCENT
		(b)	FOURESS
		(c)	R & D MULTIPLES
12.0	GUN METAL/BRASS/ BRONZE VALVES	(a)	LEADER VALVES
		(b)	SARKAR
		(c)	LEVCON
		(d)	BOMBAY METAL & ALLOYS
		(e)	SANT ENGG
		(f)	BANKIM & COMP.
		(g)	BDK
13.0	FORGED STEEL VALVE	(a)	FOURESS LIMITED
		(b)	KSB LIMITED
		(c)	L & T
		(d)	BANKIM
		(e)	BDK VALVES



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		(f)	LEADER
		(g)	A.V.ENGG
		(h)	CRESCENT
		(i)	BHEL
14.0	L.D. PIPING	(a)	SETH & SURA ENGG. CO. LTD.
		(b)	IVCRL
		(c)	RAUNAQ
		(d)	ZUBERI
		(e)	INDIAN HUME PIPES LTD
		(f)	DYNAMIC SS ENGG PVT LTD
15.0	L.P.PIPING	(a)	UNITECH MACHINES, NEW DELHI
		(b)	AARTI INFRASTRUCTURE, NAGPUR
		(c)	ZUBERI, JAIPUR
		(d)	SETH & SURA ENGG CO. LTD
16.0	FLANGES & FITTINGS	(a)	ALLIANCE
		(b)	JYOTI
		(c)	EBY
17.0	MANUAL HOIST & CHAIN PULLEY BLOCK	(a)	TRACTEL TRIFOR INDIA (P) LTD.
		(b)	LIFTING EQUIPMENT & ACCESSORIES
		(c)	INDEF (HERCULES)
		(d)	BATLIBOI
		(e)	UNIVERSAL
		(f)	ABHAY INDUSTRIES
18.0	ELECTRICAL HOIST	(a)	BATLIBOI
		(b)	PBL
		(c)	GREAVES
		(d)	HOISTOMECH
		(e)	SHREE ENGINEERS
		(f)	ABHAY INDUSTRIES
		(g)	INDEF



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<u>SR. NO.</u>	<u>ITEM</u>		<u>VENDORS</u>
		(h)	UNIVERSAL
		(i)	SWIFT
		(j)	TRACTEL TRIFOR INDIA (P) LTD.
		(k)	CENTURY CRANE ENGINEERS (P) LTD.
		(l)	HERCULES HOISTS LIMITED
19.0	PAINTINGS	(a)	ASIAN PAINTS (I) LTD.
		(b)	BERGER PAINTS INDIA LTD.
		(c)	SHALIMAR PAINTS LTD.
		(d)	NEROLAC
		(e)	JHONSON & NICHOLSON
20.0	ANTI COROSSIVE COAL TAR COATING	(a)	IWL LTD
		(b)	A.R.LAMINATORS
21.0	FABRICATED MS STEEL TANK	(a)	SEAM INDUSTRIES
		(b)	ENESTEE ENGG LTD
		(c)	ERA BUILDING SYSTEM
		(d)	DIAMOND FABRICATORS (I) PVT LTD
		(e)	THERMO SYSTEMS PVT LTD
		(f)	TECHNOFAB ENGG LTD
		(g)	RATANMANI TUBES AND METALS
22.0	WELDING FLUX & FILLER WIRE	(a)	PRECISION WELD ARC LTD
		(b)	S. CHEM & ALLIED PRODUCTS PVT LTD.
22.1	GEAR BOX	(a)	ELECON
		(b)	SHANTHI
		(c)	RADICON
		(d)	NEW ALLENBURY WORKS

2.0 LIST OF APPROVED VENDORS-ELECTRICAL

1.0	VFD (LT MOTORS)	(a)	ABB
		(b)	SIEMENS
		(c)	L & T
		(d)	ALLEN BRADLEY



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		(e)	GE FANUC
2.0	CT(LT)	(a)	KAPPA
		(b)	SILCON
		(c)	PRAYOG
		(d)	PRAGATI
		(e)	CANDS
		(f)	PRECISE
3.0	FUSES FOR LT	(a)	GEC
		(b)	SIEMENS
		(c)	L & T
		(d)	STANDARD
		(e)	BUSSMANN
4.0	MCCB	(a)	L & T
		(b)	SIEMENS
		(c)	AEG
		(d)	SCHNEIDER
5.0	MCB	(a)	MDS
		(b)	SIEMENS
		(c)	SCHNEIDER
6.0	TERMINAL BLOCK & ACCESSORIES SIDE CLAMP	(a)	ELMEX
		(b)	CONNECT WELL IND
		(c)	WAGO AND CONTROLS
7.0	DOUBLE COMPRESSION CABLE GLAND	(a)	COMET
		(b)	ELECTRO MAG
		(c)	COSMOS
		(d)	POWER ENGG
8.0	CRIMPING LUGS	(a)	DOWELL
9.0	CONDUIT	(a)	SENCO
		(b)	M. CHANDRA
		(c)	NAGARJUNA
		(d)	K.K. Industries Kolkata

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10.0	CABLE LUGS	(a)	DOWEL
		(b)	CROWN
		(c)	NIKO
		(d)	FORWARD ENGG.
11.0	Above Ground Earthing Materials	(a)	M/S INAR PROILES PVT.LTD.,ANKAPALLE
		(b)	INDUSTRIAL PERFORATION (I) PVT. LTD.KOLKATA
		(c)	M/S PREMIER POWER PRODUCTS (CAL) PVT.LTD.,KOLKATA
		(d)	M/S RABI ENGINEERING WORKS PVT.LTD, KOLKATA.
		(e)	M/S UNITECH FABRICATORS AND ENGINEERS PVT. LTD.,KOLKATA
		(f)	M/S ASSOCIATED POWER STRUCTURES PVT. LTD.,GUJRAT
		(g)	M/S RUKMANI ELECTRICALS & COMPONENTS PVT. LTD., KOLKATA
		(h)	M/S RATAN ENGINEERING CO., KOLKATA
		(i)	M/S JAMNA METAL CO. PVT LTD. DELHI
		(j)	M/S PATNY SYSTEMS HYD.
		(k)	RATAN PROJECTS & ENGG. CO. P. LTD.,KOLKATA
		(l)	KANADE ANAND UDYOG, MUMBAI
12.0	SEAL OF BUSHING	(a)	TEXPLAS INDIA PVT. LTD.
13.0		(a)	PRITHVI TECHNOLOGY
14.0	LT MOTORS(415V)	(a)	BHARAT BIJLEE LTD.
		(b)	CROMPTON GREAVES
		(c)	ASEA BROWN BOVERI
		(d)	KIRLOSKAR ELECTRIC CO LTD.
		(e)	NGEF
		(f)	SIEMENS

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		(g)	MARATHON
		(h)	GE-POWER
		(i)	RAJINDRA ELECT INDUSTRIES
		(j)	LAXMI HYDRAULICS PVT. LTD

3.0 LIST OF APPROVED VENDORS – CIVIL

<u>SR.NO.</u>	<u>ITEM</u>		<u>VENDORS</u>
	<u>NDCT</u>		
1.0	FILL	(a)	BRENTWOOD
		(b)	MUNTERS EUROFORM
		(c)	PAHARPUR
		(d)	HAMON
		(e)	MMAQUA
		(f)	COOLDECK
		(g)	M/s Hewitech GMBH & CO., Germany
2.0	FILL GLUE	(a)	AS PER FILL MANUFACTURER'S RECOMMENDATION
3.0	TESTING AGENCY FOR PVC FILL	(a)	SRIRAM LABS, NEW DELHI
		(b)	CIPET, CHENNAI
4.0	SLIDE GATES	(a)	GMW
		(b)	MACMAT
		(c)	MAHINDRA ASSOCIATES
5.0	STEEL	(a)	SAIL
		(b)	TATA
		(c)	JINDAL
		(d)	VIZAG STEEL
6.0	PVC PIPES	(a)	FINOLEX
		(b)	SUPREME CHEMPLAST
		(c)	PRINCE
7.0	PUSH TROLLEY, CHAINPULLEY BLOCK, HOOK & CHAIN	(a)	WMI
		(b)	INDEF
8.0	RED OXIDE ZINC CHROMATE	(a)	'APCOMIN' OF ASIAN PAINTS



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SR.NO.	ITEM		VENDORS
	PRIMER	(b)	BISON UNIVERSAL OF BRITISH PAINTS
		(c)	'3100' OF JANSON & NICHOLSON
		(d)	SYNTHETIC ZINC CHROMATE OF SHALIMAR PAINTS
9.0	EPOXY PRIMER	(a)	HINDUSTAN CIBA GEIGY
		(b)	DR.BECK & CO
		(c)	CHEM.E.LEEK
		(d)	EQUIVALENT
10.0	EPOXY PAINT	(a)	HINDUSTAN CIBA GEIGY
		(b)	DR.BECK & CO
		(c)	EQUIVALENT
11.0	AVIATION WARNING LIGHTS	(a)	FLASH TECHNOLOGY USA
		(b)	AVAIDS TECHNOVATORS PVT LTD GURGAON
12.0	NOZZLES	(a)	ZEMCAL (INDIA)
		(b)	VALQUA PRODUCTS CHENNAI OR EQUIVALENT.
13.0	AC PIPES	(a)	KANORIA
		(b)	CHARMINAR
		(c)	MRK PIPES, JAIPUR OR EQUIVALENT.
	VENDORS FOR OTHER CIVIL WORKS		
1.0	TMT REINFORCEMENT BAR	(a)	STEEL AUTHORITY OF INDIA LTD (SAIL)
		(b)	TATA IRON & STEEL CO. LTD
		(c)	RASHTRIYA ISPAT NIGAM LTD (RINL)
		(d)	M/S. SHYAM STEEL INDUSTRIES LIMITED, KOLKATA
		(e)	ESSAR STEEL.
		(f)	JSW STEEL.
2.0	CEMENT	(a)	THE ASSOCIATED CEMENT COMPANIES LTD. (ACC)
		(b)	AMBUJA CEMENT LTD.
		(c)	ULTRA TECH CEMENT LTD.
		(d)	M/S ANDHRA CEMENT
		(e)	M/S. INDIANA CEMENTS LIMITED.
		(f)	MANIKGAD CEMENTS



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SR.NO.	ITEM		VENDORS
		(g)	ORIENT CEMENTS
3.0	STRUCTURAL STEEL	(a)	STEEL AUTHORITY OF INDIA LTD (SAIL)
		(b)	TATA IRON & STEEL CO. LTD
		(c)	RASHTRIYA ISPAT NIGAM LTD (RINL)
		(d)	JINDAL STEEL
		(e)	ESSR STEEL.
4.0	STAINLESS STEEL	(a)	STEEL AUTHORITY OF INDIA LTD. (SAIL)
5.0	GROUTING MATERIAL	(a)	FOSROC CHEMICALS (I) PVT LTD.
		(b)	M/S BASF (INDIA)
		(c)	SIKA QUALCRETE PVT LTD.
		(d)	CICO TECHNOLOGIES LTD
		(e)	M/S BLACK CAT ENTERPRISES
		(f)	M/S PIDILITE INDUSTRIES
6.0	PLASTICISER IN WATER PROOFING MATERIAL	(a)	FOSROC CHEMICALS (I) PVT LTD
		(b)	SIKA QUALCRETE PVT LTD
		(c)	CICO TECHNOLOGIES LTD
		(d)	M/S. BLACKCAT ENTERPRISES
		(e)	M/S BASF CONSTRUCTION CHEMICALS
		(f)	M/S PIDILITE INDUSTRIES
7.0	WELDING ELECTRODES	(a)	M/S. ESAB INDIA LIMITED
		(b)	M/S. ADOR WELDING LIMITED
		(c)	M/S. GENERAL ELECTRODES & EQUIPMENTS LIMITED
		(d)	M/S. MODI ELECTRODES LIMITED
		(e)	M/S. MORGARDSHARMMER INDIA LTD., DELHI.
		(f)	M/S. WELDWELL ELECTRODES, NAGPUR.
8.0	ROOF WATER PROOFING – BITUMINOUS MEMBRANE	(a)	SHALIMAR TAR PRODUCTS LTD
		(b)	TEXA
9.0	ROOF WATER PROOFING – ELASTOMERIC MEMBRANE OR CHEMICAL (PAINT/ADMIXTURE/COMPOUND)	(a)	TEXA
		(b)	ICHNOCHEM PVT LTD
		(c)	LLOYD



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		(d)	SIKA INDIA PVT. LTD.
		(e)	ZYDEX
10.0	ROOF INSULATION – OVER DECK FOAM CONCRETE EXTRUDED POLYSTYRENE BLOCK	(a)	SIPOREX
		(b)	SUPREME INSUBOARD
11.0	FALSE CEILING-		
	(A) ALUMINIUM	(a)	LLOYD
		(b)	ARMSTRONG
		(c)	LUXALON BY HUNTER DAUGLAS,
	(B) MINERAL FIBRE / GYPSUM BOARD	(a)	ARMSTRONG
		(b)	INDIA GYPSUM
		(c)	AMF
		(d)	EVEREST
12.0	ALUMINIUM EXTRUDED SECTIONS	(a)	HINDALCO
		(b)	DOMAL-HYDRO SYSTEMS
13.0	STEEL DOOR	(a)	NCL ALTEK & SECCOLOR LTD
		(b)	AGEW STEEL MFRS P LTD
		(c)	GANDHI ENTRANCE AUTOMATION PVT LTD.
		(d)	GODREJ
14.0	STEEL GATE	(a)	GANDHI ENTRANCE AUTOMATION PVT LTD.
15.0	FIRE DOOR	(a)	GODREJ
		(b)	NAVAIR
		(c)	GANDHI ENTRANCE AUTOMATION PVT LTD.
		(d)	PROMAT
16.0	STEEL WINDOW	(a)	NCL ALTEK & SECCOLOR LTD
17.0	DOOR HARDWARE	(a)	HAFELE
		(b)	GODREJ
		(c)	DORMA
18.0	STEEL REINFORCED PVC DOORS & WINDOWS	(a)	FENESTA BY DSC LTD.
19.0	ROLLING SHUTTER	(a)	DITEC-GANDHI ENTRANCE AUTOMATION PVT. LTD
20.0	PAINTS	(a)	ICI



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		(b)	BERGER
		(c)	ASIAN PAINTS
		(d)	NEROLAC
		(e)	SNOWCEM
21.0	GRANULAR TEXTURED FINISH	(a)	VINERATEX
		(b)	HERITAGE OF BAKELITE HYLAM
22.0	SYNTHETIC PLASTER	(a)	RENOVO
23.0	ALUMINIUM COMPOSITE PANELS- NAME OF SYSTEM PROVIDER-	(a)	ALUDECOR
		(b)	EUROBOND
		(c)	ALU BOND
24.0	METAL CLADDING – INSULATED AND NON INSULATED	(a)	LLOYD INSULATIONS (INDIA) LTD
		(b)	TATA BLUE SCOPE STEEL
		(c)	CRIL
		(d)	METECHNO
25.0	METALLIC FLOOR HARDENER NON METALLIC FLOOR HARDENER	(a)	IRONITE
		(b)	SIKA INDIA PVT. LTD.
26.0	SELF LEVELLING EPOXY FLOORING	(a)	SIKA INDIA PVT. LTD.
27.0	VITRIFIED TILES	(a)	MARBONITE
		(b)	"FERRASTONE" OR "HARDSTONE" OF "BOSS PROFILE LTD"
		(c)	RESTILE
		(d)	ENDURA" OF H & R JONSON (INDIA) PVT. LTD
		(e)	KAJARIA
		(f)	NITCO
28.0	CHEMICAL RESISTANT TILES	(a)	CHEMSTONE OF BOSS PROFILES LTD
		(b)	RESTILE CERAMICS LTD
		(c)	FOSROCK
29.0	CHEMICAL RESISTANT THERMO PLASTIC PPG LINING ROLLS	(a)	CRESCENT TECHNOLOGIES PVT. LTD
30.0	VINYL FLOORING	(a)	ARMSTRONG
		(b)	WONDER FLOOR



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		(c)	KRISHNA VINYL
31.0	GLASS	(a)	PILKINGTON GLASS INDIA PVT. LTD.
		(b)	AIS OF ASAHI INDIA GLASS LTD
		(c)	MODI GLASS
32.0	POLY CARBONATE SHEET WITH SUB-STRUCTURE SYSTEM PROVIDER	(a)	MCCOY ARCHITECTURAL SYSTEMS PVT. LTD.
		(b)	CITADEL ARCHITECTURAL SOLUTIONS PVT. LTD.
33.0	STAINLESS STEEL SINK WITH INTEGRATED DRAIN-BOARD		FRANKE
34.0	TOILET FIXTURES	(a)	KOHLER
		(b)	HINDWARE
		(c)	PARRYWARE
		(d)	NYCER
		(e)	CERA
35.0	TOILET FITTINGS	(a)	KOHLER
		(b)	JAQUAR
		(c)	ESCO
		(d)	ESS ESS
36.0	EXPANSION JOINT CONTROL	(a)	C/S ALLWAY BY MCCOY SILICONES LTD.
37.0	SILICÓN SEALANT	(a)	MCCOY SILICONES LTD.
38.0	INSULATION	(a)	TWIGA- FOR GLASS WOOL INSULATION
		(b)	MINERAL ROCK FIBERS LTD.- FOR MINERAL FIBER WOOL INSULATION
		(c)	INSUBOARD" BY THE SUPREME INDUSTRIES LTD – FOR EXTRUDED POLYSTYRENE FOAM INSULATION

NOTE:- 1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL.
BIDDER TO PROPOSE SUB VENDOR WITHIN 4 WEEKS OF PLACEMENT OF LOI. THEREAFTER NO REQUEST FOR ADDITIONAL SUB-VENDOR SHALL BE ENTERTAINED.

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2. DEALERS ARE NOT ACCEPTABLE FOR ANY ITEM OF THE PACKAGE. BIDDER SHALL PROCURE ALL ITEMS INCLUDING PLATES, STRUCTURAL, FLANGES; COUNTER FLANGES ETC. FROM APPROVED SUB VENDOR ONLY.
3. THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/CUSTOMER. HOWEVER THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER.

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ANNEXURE-III**FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES**



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1.0 PERFORMANCE GUARANTEES

1.1 GENERAL REQUIREMENTS

1.1.1 The equipment shall meet the ratings and performance requirements stipulated for various equipment. The guaranteed performance parameters shall be without any tolerance values and all margins required for instrument inaccuracies and other uncertainties shall be deemed to have been included in the guaranteed figures.

1.1.2 All the guarantees shall be demonstrated during functional guarantee/ acceptance test. The various tests which are to be carried out during performance guarantee/ acceptance test are listed in this Sub-section. The guarantee tests shall be conducted at site.

1.1.3 All instruments required for performance testing shall be of the type and accuracy required by the code and prior to the test, these shall be calibrated in an independent test Institute. The protecting tubes, pressure connections and other test connections required for conducting guarantee test shall conform to the relevant codes.

1.1.4 Tools and tackles, thermowell (both screwed and welded) instruments/ devices including flow devices, matching flanges, impulse piping & valves etc and any special equipment, required for the successful completion of the tests, shall be provided by the bidder.

1.1.5 All cost associated with the tests shall be included in the bid price.

1.1.6 Detailed Performance/Capability Test procedures containing the following shall be furnished:

- (a) Objective of the test.
- (b) Various guaranteed parameters & tests as per contract.
- (c) Method of conductance of test and test code.
- (d) Duration of test, frequency of readings & number of test runs.
- (e) Method of calculation.
- (f) Correction curves
- (g) Instrument list consisting of range, accuracy, least count and location of instruments.
- (h) Scheme showing measurement points.
- (i) Sample calculation.
- (j) Acceptance criteria.
- (k) Any other information required for conducting the test.

1.1.7 The test procedure for all conditions shall be furnished one year before the scheduled commissioning date.

1.1.8 In case during performance guarantee test(s), it is found that the equipment/ system has failed to meet the guarantees, all necessary modifications and/or replacements shall be carried out to make the equipment/system comply with the guaranteed requirements & the same shall be demonstrated by conducting another performance guarantee test. However, if the specified performance guarantee(s) are still not met but are achieved within the Acceptable Shortfall Limit specified, the equipment will be accepted after levying liquidated damages. If, however, the demonstrated guarantee(s) continue to be more than the stipulated Acceptable Shortfall Limit, even after the above modifications/replacements within ninety (90) days or a reasonable period allowed, after the tests have been completed, the Owner will have the right to either of the following:



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(I) For Category-I Guarantees

Reject the equipment/system/plant and recover from the contractor.

OR

Accept the equipment/system/plant after levying Liquidated Damages

(II) For Category-II Guarantees

Reject the equipment/system/plant and recover from the Contractor the payments already made. The performance guarantees under this category shall be called 'Category II' Guarantees. Conformance to the performance requirements under Category-II is mandatory.

(III) For Category-III Guarantees

Reject the equipment/system/plant and recover from the Contractor.

OR

Accept the equipment/system after assessing the deficiency in respect of the various ratings, performance parameters and capabilities and recover from the contract price an amount equivalent to the damages as determined by the Owner. Such damages shall however be limited to the cost of replacement of the equipment(s)/system(s), replacement of which shall remove the deficiency so as to achieve the guaranteed performance.

1.2 GUARANTEES UNDER CATEGORY- I

The performance guarantees which attract liquidated damages are as follows:

- (a) Applicable for PT plant for auxiliary power consumption. Refer Volume-III (FORMAT FOR GUARANTEED AUXILIARY POWER CONSUMPTION FIGURES)

1.3 GUARANTEES UNDER CATEGORY-II

Not Applicable for PT Plant

1.4 GUARANTEES UNDER CATEGORY-III (Applicable for PT Plant)

The parameters/capabilities to be demonstrated for various systems/ equipments shall include but not be limited to the following:

1.4.1 Noise

All the plant, equipment and systems shall perform continuously without exceeding the noise level over the entire range of output and operating frequency specified.
 Noise level measurement shall be carried out using applicable and internationally acceptable standards. The measurement shall be carried out with a calibrated integrating sound level meter meeting the requirement of IEC 651 or BS 5969 or IS 9779. Maximum permissible noise level for Blowers shall be 85 dB (A)

Sound pressure shall be measured all around the equipment at a distance of 1.0 m horizontally from the nearest surface of any equipment/ machine and at a height of 1.5 m above the floor level in elevation. Corrections for background noise shall be considered in line with the applicable standards.



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1.4.2 Equipment Parameters:

For PT Plant, functional guarantees like capacities and parameters shall be demonstrated.

1.4.3 Performance Guarantee Parameters for Raw Water Pre Treatment Plant

- (i) Each pump and blower shall be guaranteed for capacity, total dynamic head and power consumption.
- (ii) Solid Contact Clariflocculator Unit shall be guaranteed for treated water output of not less than 1818 m³/hr & 100 m³/hr continuous at rated condition.
- (iii) Capacity of Gravity Filter for rated capacity
- (iv) **Treated water quality from Solid Contact Clariflocculator shall be guaranteed for the following**
:
 - (a) Turbidity : < 15 NTU.
 - (b) Iron Content : < 0.1 ppm as Fe
- (v) **Water Quality at Gravity Filter Outlet**
 - (a) Turbidity : < 2 NTU
 - (b) Organic Content : Nil
- (vi) Backwash water requirement on an average shall not exceed 2% of the water treated between two backwashes.

1.5 TEST CODES, CONDITIONS ETC

Performance Guarantee Test Procedure for Raw Water Pre Treatment Plant

- 1.5.1 After water supply is established, the flow control valve at inlet to Aerator cum Stilling Chamber should be adjusted to give rated output.
- 1.5.2 Isolation gates shall be adjusted to ensure equal flow distribution as determined by flow measuring device.
- 1.5.3 Bidder shall have to conduct a test during the period when the TSS is maximum. The duration, type and mode of conducting the above test shall be mutually decided upon between the Purchaser and the Bidder.

However, the duration of the test shall not be less than 72 hours continuously. These tests shall be carried out within a reasonable period from the date of commissioning of the plant. Basically the test shall be such as to prove beyond doubt the guaranteed performance of the plant under varying flow conditions (within the specified units) to the satisfaction of the Purchaser. The test procedures shall be as per relevant equivalent standards from recognized origins (where Indian Standard is not available and/or applicable).

- (a) The average Suspended Solids in the treated water from Clariflocculator shall not exceed 10 ppm and any individual reading shall be within 15 ppm.
- (b) The test shall be deemed to be a failure when either of the limits as indicated in (d) is exceeded and retesting shall have to be arranged.

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- (c) During this test, alum, polyelectrolyte and lime dosage shall be calculated by determining the concentration, level gauge readings and duration of test. The chemical consumption value shall not exceed 15% over the requirement as established from Jar test result.
- (d) Sludge disposal system shall be periodically checked with respect to ability and sludge consistency.
- (e) By adjusting the control valve, flow shall be adjusted to 120%, 75%, 50% and 25% and tests shall be repeated each time. Feed rate of alum and lime shall be adjusted proportional to raw water flow.
- (f) The performance test shall be conducted one in fair season when turbidity is moderate and one in rainy season, when turbidity is maximum. In case turbidity during rainy season is found less than the design turbidity, then test shall be conducted with that turbidity only.
- (g) The plant must meet the guarantee with reference to turbidity, iron value, chemical consumption & ensure satisfactory performance of the chemical injection and sludge disposal system in each test run.

1.6 TESTS TO BE PERFORMED FOR GRAVITY FILTER :

- (a) Determination of bulk density, sieve analysis, uniformity co-efficient, effective size, silica content, soluble fraction in HCL and ignition loss for the filtering media.
- (b) Test shall be conducted to determine that each filter runs at its rated capacity for 24 hours continuously with an inlet clarified water turbidity level of 15 NTU and any individual reading of outlet of filter shall not exceed 2 NTU.
- (c) Backwash water requirement on an average shall not exceed 2% of the water treated between two backwashes.

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ANNEXURE IV**DRAWING/ DOCUMENTS REQUIREMENT & DISTRIBUTION SCHEDULE**

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After award of LOI, The drawing documents listed in MDL are minimum drawing/documents, which shall be submitted by the bidder for BHEL and Customer approval. However any additional drawing/document if found necessary for completion of the engineering, the same shall be submitted by bidder without any commercial & delivery implication to BHEL.

The bidder has to submit the revised drawing/document along with the compliance sheet indicating enumerate reply to all BHEL and customer comments or observations. Without compliance sheet the submission of the drawings/documents will not be considered and the delay on this account will be solely on bidder's side only. Bidder to comply with the observations of the BHEL and CUSTOMER without price & delivery implication.

Every revised submission incorporating BHEL/Customer comments shall be resubmitted within 7 day by bidder.

Bidder to further note that the submitted drawings/revised drawing, should be complete in all respects. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL's / Customer's office for across the table discussions/ finalizations/ submissions of drawings.

- (a) List and schedule of drawings/documents to be submitted after award of contract shall be as per MDL.
- Bidder to note that drawings/documents submission shall be through web based Document Management System. Bidder would be provided access to the DMS for drawings/documents approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder to ensure following at their end.
 - Internet explorer version – Minimum Internet Explorer 7
 - Internet speed – 2 mbps (Minimum preferred)
 - Pop ups from our external DMS IP (124.124.36.198) should not be blocked
 - Vendor's internal proxy setting should not block DMS application's link
 - o (<http://124.124.36.198/wrenchwebaccess/login.aspx>)
 - DMS user manuals to be used by BHEL PEM vendors for uploading, viewing, revising, commenting and tracking documents on PEM's DMS have been uploaded on PEM internet website (www.bhelpem.com) under the Vendor session.
 - For quick access bidder may refer the link <http://bhelpem.com/DMSManuals/DMSManuals.html>
- Bidder shall submit soft copy/hard copy/CD ROMs of all the finally approved drawings and O&M Manuals as required by Customer/Customer consultant/BHEL-site/BHEL-PEM. The exact number of hard copies/CD ROMs of these documents to be submitted shall be notified to the bidder at the time of detailed engineering and bidder shall submit the same without any commercial/delivery implications to BHEL/Customer.
- All the drawing documents along with the O&M manual (of all the revisions) are necessarily to be submitted in soft copies in addition to hard copies.
- Bidder to submit soft copies of all the drawing and document along with quality plans for BHEL review and approval.
- Editable copy of all the drawings and documents shall be provided.
- The date of submission of drawing documents shall be considered as the date of submission of hard and soft copies whichever is later.
- All the drawings shall be prepared on computer auto cad and other documents (like datasheet etc.) on MS office software. Bidder not complying to the requirement shall not be considered. For the execution of the contract regular meeting (generally once in 15 days or as per project requirement) is required.
- Vendor to come for meeting with the concerned dealing persons as per BHEL or customer requirement in a short notice.
- Bidder to submit instrument schedule, cable schedule and valve schedule in MS- Excel format during detailed engineering.

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- Bidder to also furnish the auto cad copy/MS-Excel/MS-word (as applicable) of the following documents after award of contract. However any other auto cad copy/MS-Excel/MS-word of any other document as per the insistence of BHEL and customer will also be submitted by the bidder without any delivery and commercial implication to BHEL and customer.

- P&IDs.
- Equipment lay out of PT Plant.
- Equipment Cable tray layout of PT Plant.
- Civil assignment drawings.
- Piping lay out drawing of PT Plant.

Other requirements

- Engineering for this project is to be carried out in Integrated Intelligent Engineering environment at BHEL end. The engineering platform on which BHEL is doing the project is based on Smart Plant Suite. This is being done to have automated interface checking and thereby minimising rework at site. The engineering for packages placed in TG Hall will essentially be done using Intelligent P&ID, Intelligent Electrical, Intelligent Instrumentation and 3D modelling. For other BOPs i.e. those outside TG hall, though the same level of integration is preferable but 3D modelling is necessarily to be done and review model in compatible format is to be provided to BHEL on stages to be agreed.

Hence in line with above, bidder is required to prepare PIDs, Electrical drawings and all layout drawings using intelligent software with capability for transfer of data to and from corresponding Software being used by PEM.

- The data of models of facilities will be made available to BHEL as per the BHEL schedule for importing into BHEL model for interface checking and raising of integrated plant model. Layout and PID/electrical drawings will be extracted from the model.
- Standard write up on format compatibility of the BHEL's engineering platform for this project is attached as File formats supported by SPPID, SPI, SPEL & SP3D (Refer Section-D1).

- e-Learning Package/Module:**

e-learning packages shall be supplied for the equipment / system for the complete pre-treatment plant along with associated electrical and C&I system. Bidder to refer Section-D1 for detail.

- Data/Reports other than listed drawings/documents will also be made available to BHEL as and when required for import into BHEL model.
- Successful bidder shall furnish detailed erection manual for each of the equipment as well as complete system supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.
- Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.
- In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion. However, in case changes are necessitated due to any constraints at customer end, delay in review/ approval of such revised drawing beyond one month will be to customer's account.



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1	PE-V0-434-158-A001	P & I Diagram for Pre-Treatment Plant	4
2	PE-V0-434-158-A002	Process Sizing Calculation for PT Plant	4
3	PE-V0-434-158-A006	Composite Plant Layout for Pre-Treatment Plant System	4
4	PE-V0-434-158-A007	Hydraulic Flow Diagram for Pre-Treatment Plant	4
5	PE-V0-434-158-A008	Hydraulic Calculation for Pre-Treatment Plant	4
6	PE-V0-434-158-A011	Valve schedule for PT Plant	12
7	PE-V0-434-158-A012	Pressure Drop calculation for PT	4
8	PE-V0-434-158-A015	G.A of Flash Mixer for PT-DM System (Valve Chamber, Parshall Flume, Stilling Chamber, Flash Mixer)	10
9	PE-V0-434-158-A016	G.A of Sludge Sump & Pump House	10
10	PE-V0-434-158-A017	G.A of Filter Backwash Pit & Pump House	10
11	PE-V0-434-158-A018	G.A of Chemical House including Overhead Tank (Top of Chemical House)	10
12	PE-V0-434-158-A019	G.A of Flash Mixer for PT-Non-DM System (Valve Chamber, Parshall Flume, Stilling Chamber, Flash Mixer)	10
13	PE-V0-434-158-A020	Basic Civil Design criteria	4
14	PE-V0-434-158-A021	I/O LIST FOR PT PLANT AREA	10
15	PE-V0-434-158-A022	G.A of Reactor Clarifier for PT-DM and PT Non-DM System including Datasheet	10
16	PE-V0-434-158-A024	Architectural details of ground floor plan, section & elevation, terrace plan etc. of Chemical house (two storied) for PTP	12
17	PE-V0-434-158-A026	MQP for Reactor Clarifier	10
18	PE-V0-434-158-A028	Civil GA, Foundation & super structure details of Cascade Aerator, Stilling Chamber, Parshall Flume & Flash Mixer for PT- DM System	12
19	PE-V0-434-158-A029	Civil GA of Reactor Clarifier for PT-DM System	12
20	PE-V0-434-158-A030	RCC details of Reactor Clarifier for PT-DM System	12
21	PE-V0-434-158-A032	CIVIL GA & RCC DETAIL OF INTERCONNECTING CHANNEL OF HRSCC FOR PT-DM TO RGSF	12
22	PE-V0-434-158-A033	Civil GA of Gravity Filter House, filtered water reservoir, sump & pump house for PTP	12
23	PE-V0-434-158-A034	RCC details for Gravity Filter House, filtered water reservoir, sump & pump house for PTP	12
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37	PE-V0-434-158-A057	Civil Design Calculation of Sludge pit, sump & pump house	12
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40	PE-V0-434-158-A060	Painting Schedule	12
41	PE-V0-434-158-A062	Pipe Schedule for PT Plant	10
42	PE-V0-434-158-A063	Civil GA, Foundation & Super structure details of Cascade Aerator, Stilling Chamber, Parshall Flume & Flash Mixer for PT- CW System	12
43	PE-V0-434-158-A065	Civil GA of Reactor Clarifier for PT-DM and Non-DM System Connecting chanel for clarifiers	12
44	PE-V0-434-158-A066	RCC details of Reactor Clarifier for PT-Non-DM System Connecting chanel for clarifiers	12
45	PE-V0-434-158-A069	Civil Design Calculation of Cascade Aerator, Stilling Chamber, Parshall Flume & Flash Mixer for PT- DM and Non-DM System	12
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50	PE-V0-434-158-A075	General Arrangement & Civil Block out details of Sluice Gate	10
51	PE-V0-434-158-A076	MQP for Sluice Gate	10
52	PE-V0-434-158-A077	Datasheet for Platform type weighing scale	10
53	PE-V0-434-158-A078	Datasheet and GA of Ball Valves for PTP	10
54	PE-V0-434-158-A079	Datasheet and G.A of Air Blower	10
55	PE-V0-434-158-A080	MQP for Dual Plate Check Valves	10
56	PE-V0-434-158-A081	MQP for Ball Valves	10
57	PE-V0-434-158-A082	MQP for Butterfly Valves	10
58	PE-V0-434-158-A083	MQP for Gate/ Globe/ Check Valves	10
59	PE-V0-434-158-A084	MQP for Diaphragm Valve	10
60	PE-V0-434-158-A085	MQP for Air Blower (Lobe Type)	10
61	PE-V0-434-158-A086	MQP for NRV Flap Type	10
62	PE-V0-434-158-A088	DATASHEET & WIRING DIAGRAM OF ELECTRICAL ACTUATOR	10
63	PE-V0-434-158-A089	INSTRUMENTS HOOK UP DRAWINGS (PT PLANT AREA)	10
64	PE-V0-434-158-A090	G.A and datasheet of Tank Agitator Assembly	10
65	PE-V0-434-158-A091	Datasheet for Strainers	10
66	PE-V0-434-158-A092	GA AND DATASHEET OF HORIZONTAL CENTRIFUGAL PUMPS WITH MOTOR	10
67	PE-V0-434-158-A093	Datasheet for header isolation valve (PT)	10
68	PE-V0-434-158-A094	Datasheet for Safety shower and Emergency KIT B	10
69	PE-V0-434-158-A097	MQP for MS Pipes	10
70	PE-V0-434-158-A098	MQP for SS Pipes	10
71	PE-V0-434-158-A099	MQP for CI/ DI Pipes & Fittings	10
72	PE-V0-434-158-A100	MQP for Tube Settler Media	10
73	PE-V0-434-158-A101	MQP for Pressure Vessel/ Atmospheric Storage Tanks	10
74	PE-V0-434-158-A102	MQP for Metering Pump (Diaphragm Type)	10
75	PE-V0-434-158-A103	MQP for Strainer Y Type	10
76	PE-V0-434-158-A104	MQP for Agitator/ Mixer	10
77	PE-V0-434-158-A107	MQP for Control Valve (Butterfly Type)	10
78	PE-V0-434-158-A108	MQP for Electrical Actuator	10
79	PE-V0-434-158-A116	MQP for Centrifugal Pumps (Horizontal & Vertical)	10
80	PE-V0-434-158-A117	MQP for Vertical Wet Pit Turbine Pump	10
81	PE-V0-434-158-A118	MQP for Drainage Pump (Submersible type)	10
82	PE-V0-434-158-A119	LCP OF REACTOR CLARIFIER FOR PT-DM and Non-DM	10

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83	PE-V0-434-158-A120	LCP OF REACTOR CLARIFIER FOR PT-DM	10
84	PE-V0-434-158-A121	INTERCONNECTION DIAGRAM AND CABLE SCHEDULE FOR PT PLANT AREA	10
85	PE-V0-434-158-A122	GA Drawing & Calculation of Electrical Hoist	10
86	PE-V0-434-158-A123	Piping Layout for PT	10
87	PE-V0-434-158-A124	Operation & Maintenance Manual	24
88	PE-V0-434-158-A125	MQP for Electrical Hoist	10
89	PE-V0-434-158-A127	Electrical Load List	10
90	PE-V0-434-158-A128	DATA SHEET FOR LOCAL GAUGES	10
91	PE-V0-434-158-A130	DATA SHEET FOR FLOW ELEMENT ALONG WITH ORIFICE CALC.	10
92	PE-V0-434-158-A131	TECHNICAL DATA SHEET FOR FLOW TRANSMITTER	10
93	PE-V0-434-158-A132	DATA SHEET FOR HAND HELD CALIBRATOR	10
94	PE-V0-434-158-A133	DATA SHEET FOR JUNCTION BOX	10
95	PE-V0-434-158-A134	DATA SHEET FOR PRESSURE TRANSMITTER	10
96	PE-V0-434-158-A136	DATA SHEET FOR LEVEL TRANSMITTER FOR PT PLANT	10
97	PE-V0-434-158-A138	TYPE TEST REPORT OF ELECTRONIC TRANSMITTER	10
98	PE-V0-434-158-A142	TYPE TEST REPORT OF JUNCTION BOX (DEGREE OF PROTECTION)	10
99	PE-V0-434-158-A143	Layout and details of interconnecting pathways and paving for all facilities	10
100	PE-V0-434-158-A144	CABLE TRAY LAYOUT OF WATER PRETREATMENT PLANT	10
101	PE-V0-434-158-A145	DRIVE LIST FOR PTP (DRIVES CONTROLLED FROM DDCMIS)	10
102	PE-V0-434-158-A147	PG TEST PROCEDURE FOR PT PLANT	20
103	PE-V0-434-158-A148	CONTROL SCHEMS FOR PT PLANT	12
104	PE-V0-434-158-A149	STEP LIST FOR PT PLANT	10
105	PE-V0-434-158-A150	DATASHEET FOR INSTRUMENT CABLE	10
106	PE-V0-434-158-A151	GA OF SLUDGE THICKNER	10
107	PE-V0-434-158-A152	GA OF SUPERNATANT COLLECTION SUMP	10
108	PE-V0-434-158-A153	GA OF THICKENED WASTE SUMP	10
109	PE-V0-434-158-A154	CIVIL GA OF THICKENED SUMP & PUMP HOUSE.	12
110	PE-V0-434-158-A155	CIVIL DESIGN CALCULATIONS OF THICKENED WASTE SUMP.	12
111	PE-V0-434-158-A156	CIVIL GA & RCC DETAIL OF THICKENER SUERNATANT COLLECTION SUMP & PUMP HOUSE	12
112	PE-V0-434-158-A158	CIVIL DESIGN CALCULATIONS OF SUERNATANT COLLECTION SUMP & PUMP HOUSE	12
113	PE-V0-434-158-A159	CIVIL GA OF THICKENER	12

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114	PE-V0-434-158-A160	REINF. DETAIL OF THICKENER	12
115	PE-V0-434-158-A161	CIVIL DESIGN CALCULATIONS OF THICKENER	12
116	PE-V0-434-158-A162	GA OF BYPASS CHANNEL & INTERCONNECTING CHANNEL OF HRSCC FOR PT-DM TO RGSF & INTERCONNECTING CHANNEL FOR HRSCC FOR PT-Non-DM TO RGSF	10
117	PE-V0-434-158-A163	QUALITY PLAN FOR SLUDGE THICKENER WITH DRIVE HEAD	10
118	PE-V0-434-158-A164	GA AND DATASHEET OF VERTICAL CENTRIFUGAL PUMPS WITH MOTOR	10
119	PE-V0-434-158-A165	GA AND DATASHEET OF VERTICAL SCREW PUMPS WITH MOTOR	10
120	PE-V0-434-158-A166	GA, CROSS SECTION, PERFORMANCE CURVE AND DATASHEET OF DOSING PUMPS WITH MOTOR FOR PRE-TREATMENT PLANT	10
121	PE-V0-434-158-A167	DATASHEET AND GA DRAWING OF DIAPHRAGM VALVES FOR PTP	10
122	PE-V0-434-158-A168	DATASHEET AND GA DRAWING OF BUTTERFLY VALVES FOR PTP	10
123	PE-V0-434-158-A169	DATASHEET AND GA DRAWING OF NRV/CHECK VALVES FOR PTP	10
124	PE-V0-434-158-A170	DATASHEET AND GA DRAWING OF GATE VALVES FOR PTP	10
125	PE-V0-434-158-A171	DATASHEET AND GA DRAWING OF PLUG VALVES FOR PTP	10
126	PE-V0-434-158-A172	DATA SHEET AND GA DRAWING FOR NON METTALIC VALVE (CPVC) FOR PTP	10
127	PE-V0-434-158-A173	GA AND DATASHEET OF PP FILTER NOZZLES (GRAVITY FILTER)	10
128	PE-V0-434-158-A174	CABLE SCHEDULE	10



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ANNEXURE-V**LIST OF MANDATORY SPARES FOR PT PLANT**

SL. NO.	DESCRIPTION	TOTAL QUANTITY INCLUDED FOR THE PROJECT
1	PRE-TREATMENT PLANT	
1.1	SPARES FOR HORIZONTAL CENTRIFUGAL PUMPS	For each service & rating
1.1.1	Shaft	One (1)
1.1.2	Shaft Sleeve	Two (2)
1.1.3	Impeller	One (1)
2.1.4	Impeller locking nut and bolt	Four (4)
1.1.5	Impeller wear ring	Four (4)
1.1.6	Casing wear ring	Four (4)
1.1.7	Oil Seal	Four (4)
1.1.8	Oil Deflector	Three (3)
1.1.9	Oil Ring	Three (3)
1.1.10	Gland Packing	Four Hundred (400)
1.1.11	Lantern Ring	Three (3)
1.1.12	Mech Seal Assembly	One (1)
1.1.13	Stationary/Carbon Packing and "O" Ring for Mechanical Seal	Three (3) Sets
1.1.14	Oil Level Gauge	Three (3)
1.1.15	Coupling	Two (2)
1.1.16	Rubber Bush for Coupling	Two (2)
1.1.17	"O" Rings	Two (2) Sets
1.1.18	Suction Strainers Element	Three (3)
1.1.19	Bearing for Pump Motor	Two (2) Sets
1.2	SPARES FOR VERTICAL TYPE CENTRIFUGAL PUMPS	For each Service & Rating
1.2.1	Complete Bowl assembly	One (1) Set
1.2.2	Impeller (s)	One (1) Set
1.2.3	Shafts	One (1) Set
1.2.4	Casing wearing (s)	One (1) Set
1.2.5	Impeller wear ring (s)	One (1) Set
1.2.6	Shaft Sleeves	Two (2) Sets
1.2.7	Shaft Couplings	One (1) Set
1.2.8	Shaft nuts & keys	One (1) set
1.2.9	Lantern rings	One (1) set
1.2.10	Bell mouth liner	One (1) Set
1.2.11	Bearings	One (1) Set
1.2.12	Pump motor coupling	One (1) Set
1.3	SPARES FOR CLARIFIERS	For each service & ratings
1.3.1	Floculator Assembly	One (1) Set
1.3.2	Gear box for Floculator Driver	1 Lot (One (1) Set of LHS & RHS as applicable)
1.3.3	Gear box for Floculator Driven	1 Lot (One (1) Set of LHS & RHS as applicable)
1.3.4	Gear box for Rail drum drive	1 Lot (One (1) Set of LHS & RHS as applicable)



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1.3.5	Oil seals for all type of gear box	Five (5) Sets
1.3.6	Worm wheel	1 Lot (One (1) Set for each type)
1.3.7	Worm wheel worm shaft	1 Lot (One (1) Set for each type)
1.3.8	Coupling complete set with nut bolts	1 Lot (One (1) Set for each type)
1.4	SPARES FOR AGITATORS	
1.4.1	Gear Box Unit Complete	One (1) of each type
1.4.2	Bearing for Gear Box Unit	One (1) Set
1.4.3	Coupling complete (Motor/Gear box and gear box/agitator)	One (1) Set
1.4.4	Coupling Bolts	One (1) Set
1.4.5	Coupling shim pack (if applicable)	Four (4) Sets
1.4.6	Oil seals	Four (4) Sets
1.5	SPARES FOR VALVES	
1.5.1	(a) Manual Diaphragm valves	10% of total quantity used for each type and size with minimum Two (2) for each type and size.
	(b) Auto Diaphragm valves	10% of total quantity used for each type and size with minimum Two (2) for each type and size.
	(c) Spare Diaphragm for above	10% of total quantity used for each type and size with minimum Two (2) for each type and size.
	(d) Diaphragm	10% of total quantity used for each type and size with minimum One (1) for each type and size.
1.5.2	(a) Non return valves (NRV)	Two (2) of each size & type
	(b) Flaps for above NRV	Two (2) of each size
1.5.3	Gate/Globe/Ball valves/plug valve/needle valve	
	(a) Upto 100 NB	20% of total quantity used for each type and size with minimum two (2) for each type and size.
	(b) Above 100 NB	One (1) of each type and size.
1.5.4	Butter fly valve	
	(a) Upto 100 NB	20% of total quantity used for each type and size with minimum two (2) for each type and size.
	(b) Above 100 NB to 400 NB, 450 NB & above	One of each type and size, One set of bearing, shaft & seal
1.6	SPARES FOR BLOWERS (Separate spares for each model shall be considered)	
1.6.1	Impeller with shaft	One (1) Set
1.6.2	Bearings	One (1) Set
1.6.3	Oil seals	Five (5) Sets
1.6.4	Filter	One (1) Set
2	SPARES C&I	
2.1	ELECTRONIC TRANSMITTERS	
2.1.1	Transmitters of all types, ranges and model no. (for the measurement of Pressure, differential pressure flow, level etc.)	10% or 2 no. of each type and model, whichever is more
2.1.2	Electronic cards / PCB's for each type and model and model of transmitters	10% or 5 nos. of each type, whichever is more
2.2	TEMPERATURE ELEMENTS	
2.2.1	RTDs of each type & length	10% or 2 nos. whichever is more
2.2.2	Thermocouples of each type like K-type, R-type, metal etc. and length	10% or 2 nos. whichever is more

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2.2.3	Thermowell for T/C & RTDs	10% or 1 no. of each type, rating, length used in the system whichever is more
2.2.4	Process actuated switch devices Including all types of pressure, differential pressure, flow, temperature, differential temperature, level switch devices	10% or 1 no. of each type and model whichever is more
2.3	INDICATORS/RECORDERS	
2.3.1	Digital Indicators of each model, type & range (including relevant digital indicators of electrical system)	10% or 2 nos. min. whichever is more
2.3.2	Vertical Indicators of each type & model	5% or 1 no. of each model whichever is more
2.3.3	Recorders for each type and model	5% or 1 no. whichever is more.
2.3.4	Consumables for continuous recorders Charts Ink capsules	25 rolls per recorder/ 25 nos. per recorder/ 20 nos. per recorder / Ink Pads /Pens.
2.3.5	Consumables for multi-point recorders	
(a)	Charts	5 nos. per recorder
(b)	Ink pads	5 nos. per recorder
(c)	Print mechanism/ print head assembly	10% or 5 nos. of each type whichever is more
2.3.6	Level transmitters (displacer type)	
(a)	Electronic cards / PCB's of level transmitters	10% of total quantity used or 1 for each type/rating whichever is more
(b)	Level transmitters	10% of total quantity used or 1 for each type/rating whichever is more
(c)	Electronic water level indicator	10% or 2 nos. min. whichever is more
2.3.7	PD type flow transmitters	10% of total quantity used or 1 for each type/rating whichever is more
2.4	SWITCHES	
2.4.1	Switches (Pressure, DP, Level, Flow, Temperature etc.)	10% of each type of total nos. used in the system or minimum 1 no. of each type, model & range whichever is more
2.5	Rotameter	10% of each type of total nos. used in the system or minimum 2 no. of each type, model & range whichever is more
2.6	SOLENOID VALVE	
2.6.1	Assembly	10% of total quantity used or minimum 2 no. of each type whichever is more
2.6.2	Coil	10% of total quantity used or 5 no. whichever is more
2.7	E/P Converter	10% of each type of total nos. used in the system or minimum 2 no. of each type, model & range whichever is more
2.8	SPECIAL INSTRUMENTS	
2.8.1	Nucleonic /non-nucleonic density meter, solid flow meter etc.	1 no. and spare parts as per manufacturer
2.9	Electrical Transducers	10% of total quantity used or minimum 1 no. of each type and range whichever is more
3.0	POWER SUPPLY SYSTEM (24 V DC POWER SUPPLY SYSTEM)	
3.1	Silicon controlled thyristors, diodes power transistors	100%
4.0	PROCESS CONNECTION PIPING (for impulse piping /tubing, sampling piping/ tubing and air supply piping as applicable)	
4.1	Valves of all types and models	10% or 2 no. of each type, class, size and model whichever is more.

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4.2	2 way, 3way, 5way valve manifolds	10% or 2 no. of each type, class size and model whichever is more.
4.3	Fittings	10 nos. of each type
4.4	Purge meters	10 % of each model or 2 Nos. whichever is more
4.5	Filter regulators	10% of each model or 2 Nos. whichever is more
4.6	Impulse pipe & tubing of all type	20 mtrs each type & size
4.7	Impulse line root valve	10% of total quantity used or 4 no. whichever is more for each type and rating of each size
4.8	SS tube	40 mtrs of each type/size
4.9	Fitting for SS tube	40 nos. of each type/size
5.0	INSTRUMENTATION CABLE, INTERNAL WIRING AND ELECTRICAL FIELD	
5.1	Pre fabricated cable of each type	10% of installed quantity
5.2	Pre fabricated cable connector	10% or 1no. of each type and model, whichever is more.
5.3	Other cables	10% of each type, pair and size of actual installed quantity
6.0	ELECTRICAL ACTUATORS	
6.1	Actuators	10% or 1 no. of each type, model and rating, whichever is more.
6.2	Power unit for modulating actuator	10% or 2 nos. of each type, whichever is more.
6.3	DC-DC unit/power pack units	10% or 2 nos. of each type, whichever is more.
6.4	Electronic cards	10% or 5 nos. of each type, whichever is more
6.5	Brake assembly	10% or 2 nos. of each type, whichever is more..
6.6	Brake coils	10% or 2 nos. of each type whichever is more.
6.7	Position feed back transmitters	10% or 2 nos. of each type whichever is more.
6.8	Control unit	10% or 2 nos. of each type whichever is more
6.9	Torque and limit switch assembly of each unit	10% or 2 nos. of each type, whichever is more.
6.10	O-ring	1 set of each size
6.11	Motor	1 no. of each type & rating
6.12	Auxiliary contact	10% of total quantity used or 2 nos. whichever is more for each type and rating of each size
6.13	Seal kit	1 set of each type & size
7.0	RADAR TYPE LEVEL TRANSMITTER	
7.1	Transmitter/Receiver	10% or 1 no. of each type transmitter/ receiver
7.2	Electronic card	10% or 1 no. of each type electronic card
8.8	ANNUNCIATION SYSTEM (For offsite / Auxiliary Plants)	
8.8.1	Each type of PCB (for non-PLC driven system)	1(one) No. each
8.8.2	Lamp Box with Facia & Lamps (LED type)	10% with minimum 2 nos.
8.8.3	Hooter	1(one) No.
9.0	Gauges of all types	10% of total quantity used or 1 nos. whichever is max. for each type/rating
10.	ELECTRICAL	

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10.0	MOTORS	
10.1	Terminal plates for motors upto 30kw for each rating	1 nos. For each type & rating of Motor
10.2	Terminal plates for motors above 30kw for each rating	1 nos. For each type & rating of Motor
10.3	Heaters	1 set For each type & rating of Motor
10.4	Greasing arrangements	1 set For each type & rating of Motor
10.5	Motor of each type and rating	10% of the installed quantity or minimum 1 number whichever is higher
10.6	Bearings (DE and NDE)	1 set For each type & rating of Motor
10.7	End shield cover driving and non-driving end	1 set For each type & rating of Motor
10.8	Cooling fan	1 set For each type & rating of Motor
10.9	Motor terminal block	1 set For each type & rating of Motor
10.10	Complete set of coupling	1 set For each type & rating of Motor
10.2	VARIABLE FREQUENCY DRIVE	
10.2.1	Thyristor	12 nos
10.2.2	Ignition transformers	12 nos
10.2.3	Firing cards	4 nos
10.2.4	Control transformers	2 nos
10.2.5	Auxiliary contactors	2 nos each
1.	Wherever quantity has been specified percentage (%) the quantity of mandatory spares to be provided by the bidder shall be type (as the case may be) in the same proportion of the main population. In case the quantity so calculated happens to be fraction, the same should distributed into various ranges /size /rating/next higher whole number.	
2.	Interchangeability and Packings: All spares supplied under this contract shall be strictly interchangeable with parts for which they are intended for replacements. These spares shall include all mounted accessories like components, boards, add or items, fittings, connectors etc. and be complete in all respects so that the replacement of the main items by these spares does not require additional item. All electronic modules should be pre set and/or preprogrammed for ready use at site. Alternatively, suitable instruction sheet indicating details of required PCB jumper position, BCD which is setting, EPROM/ROM listing etc should be packed along with each module. Also a caution mark sign should be puon all such module which needs pre setting/ re programming before putting them in to service. The spare shall be treated and properly packed for long term storage.	
3.	Wherever quantity has been specified as percentage (%), it shall mean percentage (%) of the total population of the item in the station (project), unless specified otherwise and the fraction will be rounded off to the next higher whole number.	
4.	Wherever the quantities have been indicated for each type, size, thickness, material, radius, range etc. these shall cover all the items supplied and installed and the break up for these shall be furnished in the bid.	
5.	In case spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities generally in line with the approach followed as per the above list.	
6.	Identification: Each spare shall be clearly marked and labeled on the outside of the packing with its description. When more than one spare part is packed in single case, a general description of the contents shall be shown on the outside of such case and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purpose of identification.	

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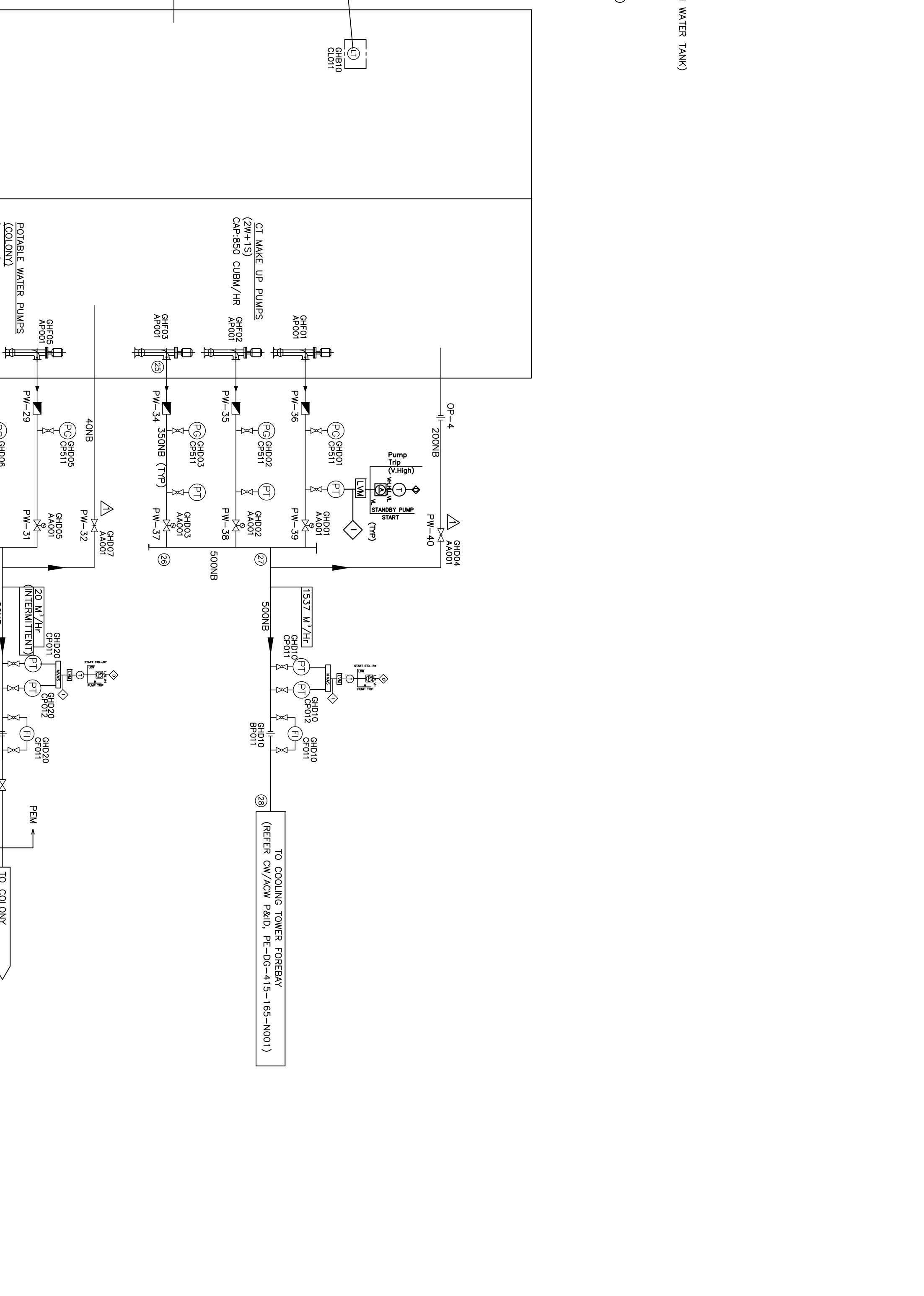
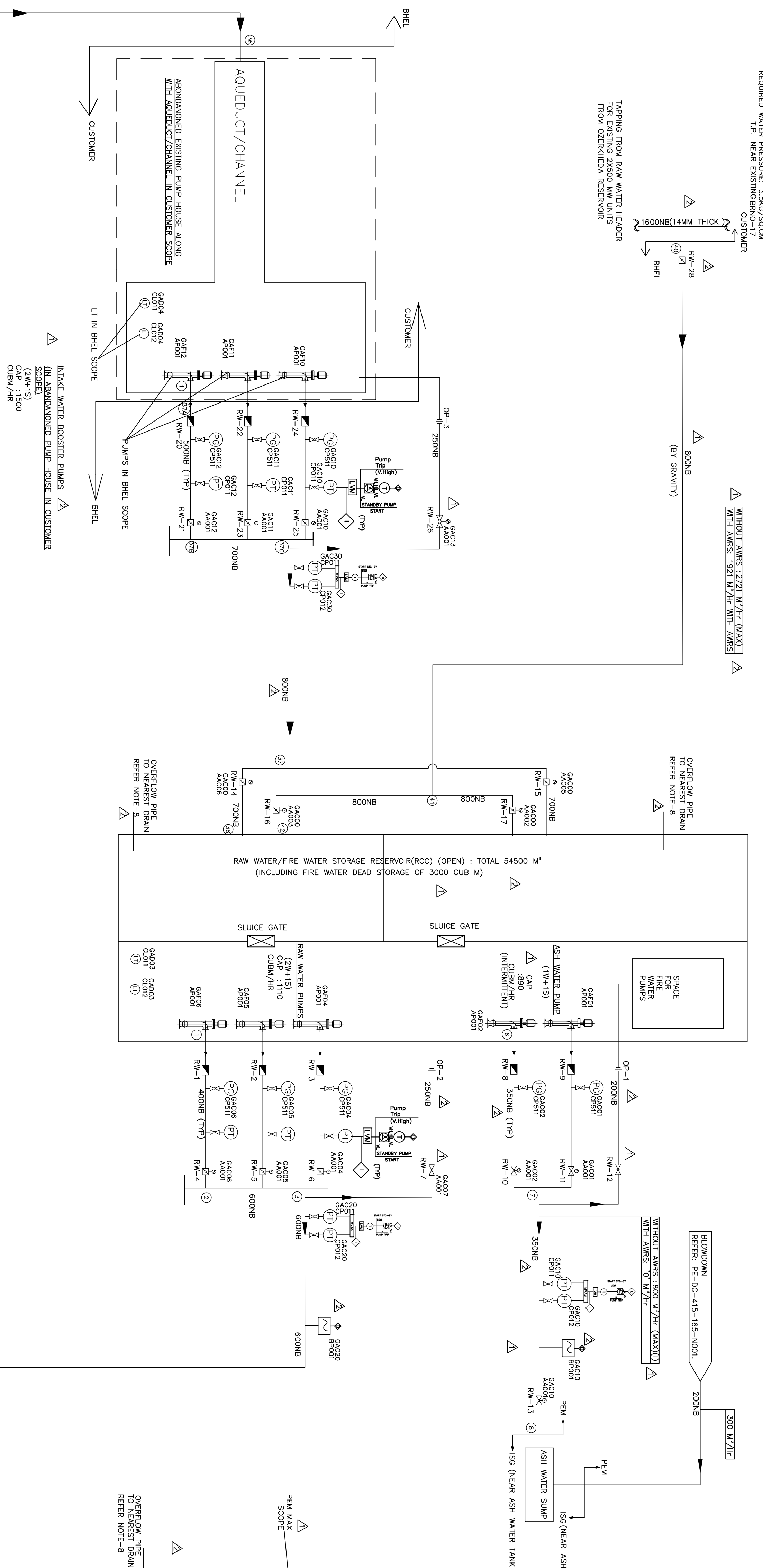
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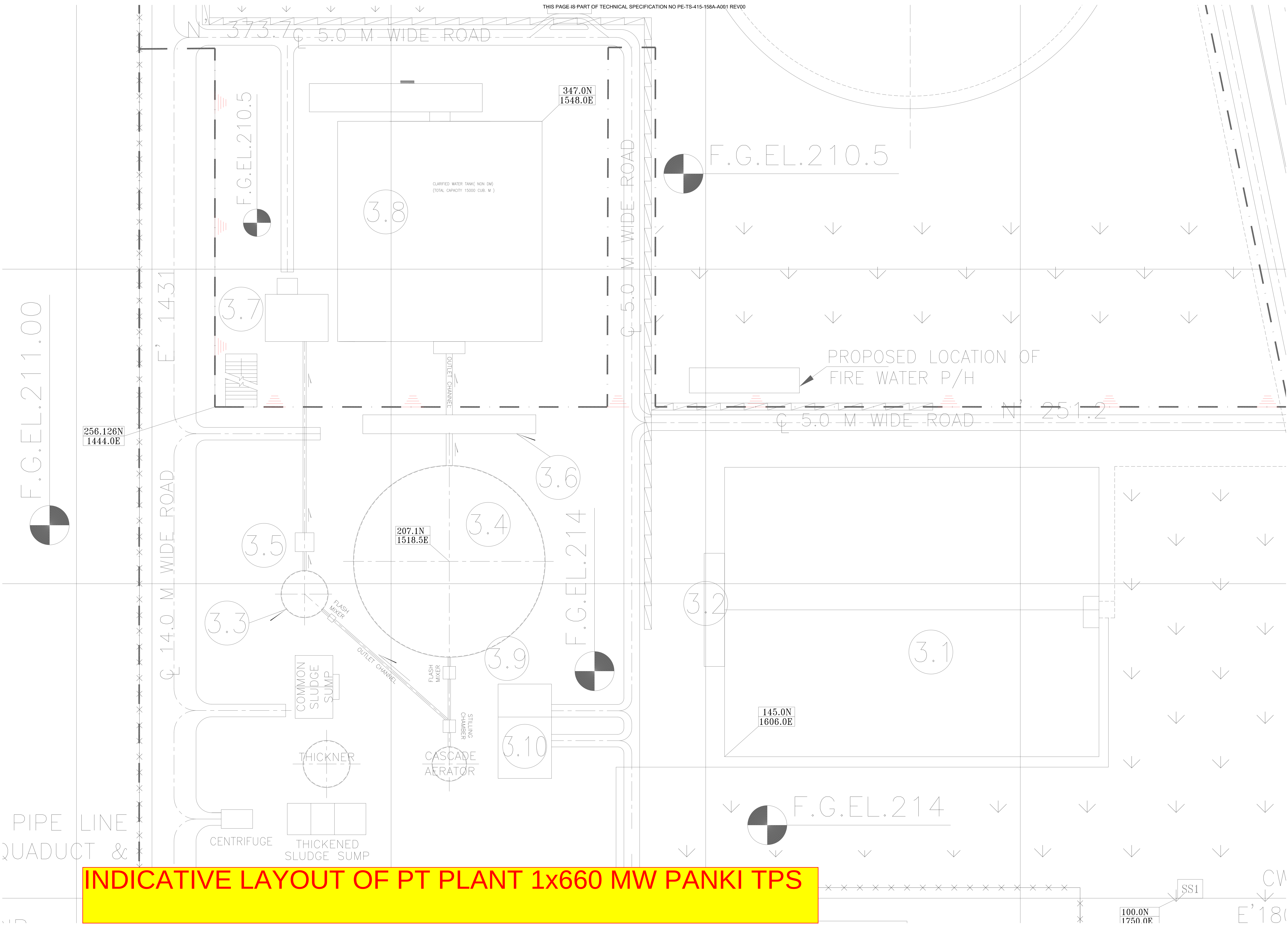
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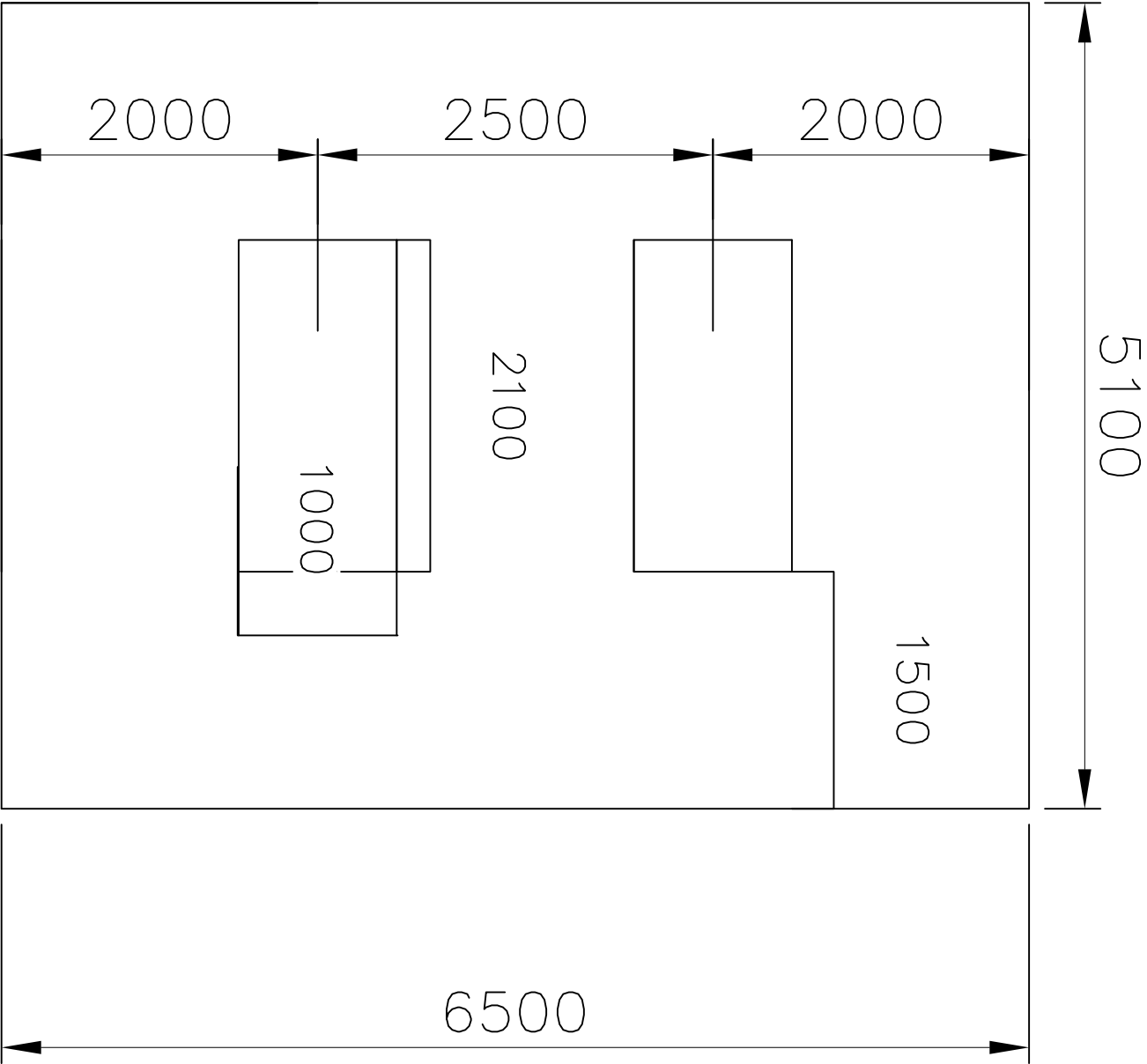
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DRAWINGS





INDICATIVE LAYOUT OF PT PLANT 1x660 MW PANKI TPS



TENTATIVE INPUT FOR DM PLANT FEED PUMP FOUNDATION
(1X660MW BHUSAWAL TPS-UNI:6)

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DATASHEET-A
(PRE TREATMENT PLANT)



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DATA SHEET – A

1.	INLET VALVES motorized butterfly flow control valve, located at inlet to aerator, with manual upstream and downstream isolation valves along with by-pass manual butterfly flow valve. Control valve shall have “auto manual” selection option, position indicator with “open-close” push buttons. Inching operation of valve shall be possible from DDCMIS.	
1.1	Control	Under “ Auto” mode of flow control valve, valve shall automatically maintain the level of water in the clarified water reservoir, i.e valve shall automatically close when reservoir level becomes high.
1.2	Material of Construction of Pipe	MS ERW to IS-3589
1.3	Inlet valves	
1.3.1	Number of control valve	One (1)
1.3.2	Type	Electric motor actuated type butterfly valve long body as per AWWA–C-504.
1.3.3	Size	600 NB
1.3.4	Number of isolating & By pass valve for control valve	Two (2) and One (1)
1.4	Material of construction	
1.4.1	Body & disc	2% Ni Cl to IS: 210 Gr. FG 260
1.4.2	Valve spindle (Shaft)	18-8 type SS to ASTM A479 type 316
1.4.3	Bearing & Gland packing	Teflon
1.4.4	Valve seat	18-8 type SS-316 ASTM A351 Gr. CF8M
1.4.5	Disc seat	Renewable Nitrile rubber 70 to 75A shore hardness.
1.4.6	Seal retaining ring	18-8 type SS-316
1.4.7	Bolts and nuts	Cadmium plated high tensile steel.
1.4.8	Gear casing	Grey cast iron to IS: 210 Gr. FG260, Water tight casing
1.4.9	Gears	Phosphor Bronze
1.4.10	Pinions	Nickel molybdenum steel.
1.4.11	Pinion screw hardware	SS 316
2.	CASCADE AERATOR	
2.1	Numbers To be provided	One (1) (Common for DM & Non-DM)
2.2	Description	
2.2.1	Type	Cascade
2.2.2	Maximum demand	2100 M3/hr
2.2.3	Effective Capacity (m ³ /hr)	To be arrived at based on water balance with 5 % margin on the maximum demand (factoring in the water loss thru sludge disposal.).
2.2.4	Design residence time, (sec)	2
2.2.5	Design minimum surface flow rate for Aerator (m ² /m ³ /hr)	0.03
2.2.6	Design Temperature, °C	60
2.3	Material of Construction	RCC with peripheral walkway
2.4	Accessories	To be provided as per Tender P&ID.
3.	STILLING CHAMBER	
3.1	Numbers To be provided	One (1) - Common for DM & Non-DM



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3.2	Description	
3.2.1	Type	Stilling Chamber provided with baffle wall inside.
3.2.3	Purpose	To dampen out any turbulence of incoming water for ease of flow measurement and for ozonization. (Ozonization in BHEL scope).
3.2.3	Effective Capacity (m ³ /hr)	By bidder; minimum 2100.
3.2.4	Design residence time	120 seconds in order to dampen out any turbulence of incoming water and ensure complete ozonization of raw water.
3.2.5	Size	Bidder to indicate
3.2.6	Design Temperature	60
3.3	Material of Construction	RCC
3.4	Accessories	Suitable draining arrangement shall be provided for the stilling chamber and drain line shall be extended up to the sludge pocket for final disposal to common sludge sump.
4.	PARSHALL FLUME	
4.1	Numbers to be provided	Two (2) (One each for DM & Non-DM) with isolation gates at inlet for interchangeability in operation and maintenance.
4.2	Description for each inlet Channel	
4.2.1	Type	Rectangular in cross section.
4.2.2	Type of fluid to be handled	Raw water
4.2.3	Effective Capacity (m ³ /hr)	As per system requirement, however 1818 and 100 (minimum) for Non- DM and DM respectively.
4.2.4	Size	Bidder to indicate.
4.2.5	Minimum Free Board	300 mm.
4.2.6	Design Temperature, °C	60
4.3	Material of Construction	RCC
4.4	Special features	Both local mounted Rate of Flow Indicator as well as panel mounted Rate of Flow Indicator - Integrator - Recorder for each Inlet Channel. The primary flow element shall be Parshall flume type. Each Integrator shall be electronic and have LED digital display (6 digits) along with manual reset facility. Primary transmitter shall be at Parshall flume in a float chamber. Flushing and draining provision of each float chamber shall be provided. Multipoint Recorder shall be one (1) in no. There shall be one Integrator to indicate totalized water flow through all the Inlet Channels.
5.	FLASH MIXERS	
5.1	Numbers to be provided	Two (2) (One for DM + One for Non-DM)
5.2	Construction	Radial, RCC
5.3	Detention time (minimum) (Sec)	Sixty (60)
5.4	Agitator	Turbine type AC electric motor operated through reduction gear, MOC-SS 316 OR



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		Criss-Cross flow design as per IS:7090
5.5	Protective cover of GI construction for motors and gear drives.	Required – protection for motors – IPW-55 (outdoor duty)
6.	CLARIFLOCCULATOR	
6.1	Numbers To be provided	Two (2) (One for DM + One for Non-DM)
6.2	Description for each Clariflocculator	
6.2.1	Type	Clariflocculator
6.2.2	Output Capacity for each at rated condition, m ³ /hr	1818 & 100
6.2.3	Suspended Solid of treated water at rated condition, ppm	Not to exceed 15
6.2.4	Minimum Residence time in Flocculation zone	30 min
6.2.5	Minimum Residence time in Clarification zone	150 min
6.2.6	Surface flow rate in Clarification zone	Not to exceed 1.2 m ³ /hr/m ²
6.3	Material of Construction	Radial RCC
6.4	Flocculators	
6.4.1	Number	Two (One (1) for each Clariflocculator)
6.4.2	Material of construction	SS 316
6.5	Rake mechanism	
6.5.1	Number	Two (One (1) for each Clariflocculator)
6.6	Material of construction	Epoxy painted carbon steel complete rubber squeezers
6.7	Sludge disposal arrangement	
6.7.1	Continuous	By gravity through telescopic standpipe
6.7.2	Intermittent	Main sludge disposal line shall consist of manual adjustable timer operated blow-off valve with manual over riding facilities
6.8	Accessories	To be provided as per P&ID, enclosed with the Specification.
6.9	Instruments	To be provided as per P&ID, enclosed with the Specification.
6.10	Painting	Painting shall be as per the relevant sub section.
6.11	Walkway	To be provided with handrails around launder periphery of each Clariflocculator. Width of the walkway shall not be less than 1200 mm
7.	SLUDGE SUMP	
7.1	Numbers to be provided	One (common for Both Clariflocculators)



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7.2	Description	
7.2.1	Type	Rectangular with two compartments and flat bottom.
7.2.2	Type of fluid to be handled	Clariflocculator sludge and other fluids as per P&ID
7.2.3	Effective capacity of each compartment (m ³)	As per design; Minimum 125 m ³ of each compartment.
7.2.4	Minimum Free Board, in mm.	500
7.3	Material of Construction	RCC
7.4	Type of Protection	
7.4.1	Internal	Epoxy screed lining with 3 – 5 mm thickness
7.4.2	External	Not applicable
7.5	Sludge Flushing Arrangement	Required through high pressure water and nozzles to ensure no deposition/ settling of sludge as per the Tender P&ID. Water shall be taken from service water pump discharge header. Booster Pump if required, for producing high pressure water, shall be in the Bidder's scope.
7.6	Accessories	To be provided as per P&ID, enclosed with the Specification.
7.7	Instruments	To be provided as per P&ID, enclosed with the Specification.
8.	THICKENED SLUDGE SUMP	
8.1	Number	One (1) with two compartments.
8.2	Capacity (effective) Each section	Not Less than 25 cum for each compartment
8.3	Dimension	Suitable
8.4	MOC & Type	RCC with coal tar epoxy paint inside, underground, outdoor local
8.5	Location	Shall be finalized during Detailed Engineering (DDE).
8.6	Special arrangement	Agitation/ recirculation line shall be provided in pit.
8.7	Other accessories and instruments	To be provided as per P&ID, enclosed with the Specification.
9.	SLUDGE TRANSFER PUMPS	
9.1	Number	Two (2) (1W, 1 S)
9.2	Description for each Pump	
9.2.1	Type	Vertical, Centrifugal Non Clog type
9.2.2	Type of Impeller	Open
9.2.3	Location	Outdoor
9.2.4	Fluid to be handled	Sludge-water Slurry
9.2.5	Duty	Intermittent, suitable for parallel operation
9.3	Design Standard	As per Tender Specification
9.4	Design Temperature, °C	60
9.5	Rated Capacity (m ³ /hr)	By Bidder; Minimum 100.
9.6	Suction Condition	Flooded.
9.7	Tentative Head to be developed at rated capacity, MLC	By bidder.



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9.8	Shut off Head	To be suitable for stable operation at rated duty point.
9.10	Range of operation	20% - 120%
9.11	Pump speed (RPM),maximum	1500
9.12	Material of construction	
9.12.1	Casing	Ni hard C.I. as per ASTM 532
9.12.2	Shaft	EN-8 as per BS-970
9.12.3	Impeller	Ni hard C.I. as per ASTM 532
9.12.4	Nuts and Bolts	SS-316 (under wetted condition) and MS Cadmium plated (in other places)
9.13	Type of drive	Electrical Motor
9.14	Rated speed (RPM),maximum	1500 (Sync.)
9.15	Voltage, Phase & Frequency ($\pm$ % Variation)	415 V (+10%), 3 Phase, 50 HZ (+3 to -5%)
9.16	Type of coupling between Pump & Motor	Flexible Spacer
9.17	Noise level (for complete set of Pump & Motor)	Not more than 85 dB (At a distance of 1.0 m from the outer surface of Motor)
9.18	Painting for complete set of Pump & Motor	
9.18.1	Primer	As per the requirements of Painting Specification
9.18.2	Finish paint	As per the requirements of Painting Specification
9.18.3	Shade	As approved by Purchaser
9.19	Tests and Inspection	
9.19.1	Material Test required for	Casing, Impeller, Shaft and Shaft Sleeve
9.19.2	Hydro-test	As per IS-1520 and IS-5120.
9.19.3	Dynamic Balancing Test	To be provided
9.19.4	Performance Test	Required as per Tender Specification
9.20	Instruments along with alarms, interlocks and accessories	To be provided as per the requirements of the Tender Specification and Drawings, enclosed with it
9.21	Start and stop facility provided both at local and remote	To be provided in conjunction with Auto Start Facility
9.22	Trip interlock	To be provided
10.	SLUDGE THICKENER	
10.1	Number	One
10.2	Capacity, Cum/hr	As required, TSS shall be considered as indicated in water analysis for capacity calculation
10.3	Inlet Solid Concentration	2 % from Clarifier at maximum turbidity
10.4	Outlet concentration(minimum)	5% maximum at maximum turbidity
10.5	Material of construction	RCC with coal tar epoxy screed lining 5 mm thick.



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11.	THICKENED SLUDGE TRANSFER PUMPS	
11.1	Number	Two (2) (1W + 1S)
11.2	Type	Screw
11.2.1	Capacity and head	As required
11.2.2	Liquid to be handled	Thickener sludge at 5% concentration
11.3	Material of construction	
11.3.1	Pump casing	Cast Iron IS : 210 FG 260, 2% Ni
11.3.2	Stator	EPDM
11.3.3	Shaft	SS 316
11.3.4	Eccentric rotor	SS 316
12.	CENTRIFUGE	
12.1	Number	Two (2) (1 W + 1 S)
12.2	Type	Horizontal counter or co current type.
12.3	Capacity	As per system requirement
12.4	Inlet Solid Concentration %	5
12.5	Outlet concentration % (minimum)	25
12.6	Material of construction	
12.6.1	Bowl	SS 316
12.6.2	Conveyor	SS 316
12.6.3	Conveyor Flieght	SS 316
12.6.4	Flieght protection	Tungsten carbide from feed point to the solid discharge port holes in flieght for centrate flow axially
12.6.5	Liquid discharge port	Flexible/ changeable SS 316
12.6.6	Solid discharge port	CS hard surfacing with sintered tungsten carbide coating.
12.6.7	Feed nozzle	CS hard surfacing with sintered tungsten carbide coating.
12.6.8	Coupling	Hydraulic
12.7	Recovery %	98
12.8	Discharge hopper with valves	To be provided
12.9	Nos. For cake disposal	4 Nos. closed dumper trolley
13.	FILTERED WATER STORAGE TANK AND PUMP HOUSE	
13.1	Number	1 (One)
13.2	Type	Closed
13.3	Material of Construction	RCC
13.4	Effective Capacity	Effective total capacity of one day storage, minimum 900 CuM.
13.5	Level switch, level transmitter, alarm, indicator and controller	As per P&ID and technical specification.
13.6	Pump house	Compressor foundation foot print is attached under "Drawing" chapter. Construction of pump house shall be done by PT plant supplier considering maintenance space requirement and other layout requirements.



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14.0	ALUM SOLUTION PREPARATION TANKS	
14.1	Numbers required	Two (2) (One working common for DM & for Non-DM and one as standby]
14.2	Description (applicable for each Tank)	
14.2.1	Type	Vertical rectangular with flat bottom
14.2.2	Type of fluid to be handled	10% w/w Alum Solution
14.2.3	Effective capacity of each tank, m ³ /hr	Adequate to hold the quantity required for twelve (12) hours of operation of two (2) nos Clariflocculators each set at rated capacity plus water loss for sludge disposal through each Clariflocculator [dosing rate of alum solution is 60 ppm]
14.2.4	Free Board, mm	300
14.2.5	Size	Bidder to indicate.
14.2.6	Design Pressure, Kg/cm ² (g)	As per Tender Specification.
14.2.7	Design Temperature, °C	60
14.2.8	Design Code	As per Tender Specification
14.2.9	Code for Test and Inspection	As per Tender Specification
14.3	Material of Construction	RCC
14.4	Protection	
14.4.1	Internal	5 mm thick joint less solvent free epoxy screed lining
14.4.2	External	Not applicable
14.5	Agitator along with drive motor and all other accessories	
14.5.1	(i) Number	One (1) per Tank
14.5.2	(ii) Material of Construction	SS 316
14.6	Dissolving Basket	
14.6.1	(i) Number	One (1) per Tank
14.6.2	(ii) Material of Construction	SS 316
14.7	Accessories	To be provided as per P&ID, enclosed with the Specification
14.8	Instruments	To be provided as per P&ID, enclosed with the Specification
15.	ALUM SOLUTION INJECTION PUMPS	
15.1	Number	Two (1W+1S) for DM and Two (1W+1S) for Non-DM
15.2	Description for each Pump	
15.2.1	Type of Pump	Positive displacement and hydraulic diaphragm type with stroke adjustment.
15.2.2	Location	Indoor.
15.2.3	Fluid to be handled	10 % w/w Alum Solution.
15.2.4	Service	To dose Alum solution to the Clariflocculator
15.2.5	Duty	Continuous and suitable for parallel operation

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15.2.6	Suction Condition	Flooded
15.2.7	Rated Capacity, m ³ /hr	By bidder.
15.2.8	Tentative head to be developed at rated capacity, MLC	To be specified by the Supplier to meet the system requirements
15.2.9	Design Standard	As per Tender Specification
15.2.10	Design Temperature, °C	60
15.2.11	Range of Operation (%)	0 – 100
15.2.12	Pump Speed, (RPM)	1500
15.3	Material of construction	
15.3.1	All wetted parts	SS-316
15.3.2	Diaphragm	PTFE
15.3.3	Type of drive	Electrical Motor
15.4	Instruments along with alarms, interlocks and accessories	To be provided as per the requirements of the Tender Specification and Drawings, enclosed with it
15.5	Start and stop facility provided both at local and remote	To be provided in conjunction with Auto Start Facility
15.6	Trip interlock	To be provided
15.7	Accessories to be provided	
15.8	Pulsation Dampener	To be provided
15.9	Pressure Relief Valve	To be provided
16.	LIME SLAKING TANKS	
16.1	Numbers To be provided	Two (2) (One working common for DM & for Non-DM and one as standby)
16.2	Description for each Tank	
16.2.1	Type	Vertical rectangular with Semicircular bottom
16.2.2	Type of fluid to be handled	10 % w/w Lime Solution
16.2.3	Effective capacity of each tank, m ³	Adequate to hold the quantity required for twelve (12) hours of operation of two (2) nos Clariflocculators each set at rated capacity plus water loss for sludge disposal through each Clariflocculator. [dosing rate of lime solution is 25 ppm].
16.2.4	Free Board, mm	300
16.2.5	Size	Bidder to indicate
16.2.6	Design Pressure, kg/cm ² (g)	As per Tender Specification
16.2.7	Design Temperature, °C	60
16.2.8	Design Code	As per Tender Specification
16.2.9	Code for Test and Inspection	As per Tender Specification
16.3	Material of Construction	RCC
16.4	Type of Protection	
16.4.1	Internal	Epoxy painted as per painting sub section
16.4.2	External	Not applicable

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16.5	Agitator along with drive motor and all other accessories	
16.5.1	Number	One (1) per Tank
16.5.2	Material of Construction	SS 316
16.6	Dissolving Basket	
16.6.1	Number	One (1) per Tank
16.6.2	Material of Construction	SS 316
16.7	Accessories	To be provided as per P&ID, enclosed with the Specification.
16.8	Instruments	To be provided as per P&ID, enclosed with the Specification.
17.	SLAKED LIME TRANSFER PUMPS	
17.1	Number	Two (1W+1S) for DM and Two (1W+1S) for Non-DM
17.2	Description for each Pump	
17.2.1	Type	Horizontal Centrifugal
17.2.2	Location	Indoor
17.2.3	Fluid to be handled	10 % w/w Lime Solution
17.2.4	Duty	Continuous and suitable for parallel operation
17.2.5	Suction Condition	Flooded
17.2.6	Rated Capacity, m ³ /hr	By bidder.
17.2.7	Tentative head to be developed at rated capacity, MLC	To be specified by the Supplier to meet the system requirements
17.2.8	Design Standard	As per Tender Specification
17.2.9	Design Temperature, °C	60
17.2.10	Range of Operation (%)	0 – 100
17.2.11	Pump Speed, (RPM), maximum	1500
17.3	Material of construction	
17.3.1	All wetted parts	SS-304
17.4	Type of drive	Electrical Motor
17.5	Instruments along with alarms, interlocks and accessories	To be provided as per the requirements of the Tender Specification and Drawings, enclosed with it
17.6	Start and stop facility provided both at local and remote	To be provided in conjunction with Auto Start Facility
17.7	Trip interlock	To be provided
17.8	Accessories to be provided	
17.9	Pulsation Dampener	To be provided
17.10	Pressure Relief Valve	To be provided
18.	LIME SOLUTION PREPARATION TANKS	
18.1	Numbers required	Two (2) (One working common for DM & for Non-DM and one as standby)

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18.2	Description for each Tank	
18.2.1	Type	Vertical rectangular with flat bottom
18.2.2	Type of fluid to be handled	6 % w/w Lime Solution
18.2.3	Effective capacity of each tank, m ³	Adequate to hold the quantity required for twelve (12) hours of operation.
18.2.4	Material of Construction	RCC
18.2.5	Minimum Free Board, mm	300
18.2.6	Type of Protection	
18.2.7	Internal	Epoxy painted as per painting sub section.
18.2.8	External	Not applicable.
18.3	Agitator along with drive motor and all other accessories	
18.3.1	(i) Number	One (1) per Tank
18.3.2	(ii) Material of Construction	SS 316
18.4	Dissolving Basket	
18.4.1	(i) Number	One (1) per Tank
18.4.2	(ii) Material of Construction	SS 316
18.5	Accessories	To be provided as per P&ID, enclosed with the Specification
18.6	Instruments	To be provided as per P&ID, enclosed with the Specification
19.	LIME SOLUTION RECIRCULATION CUM DOSING PUMPS	
19.1	Number	Two (1W+1S) for DM and Two (1W+1S) for Non-DM
19.2	Description for each Pump	
19.2.1	Type	Horizontal Centrifugal
19.2.2	Location	Indoor
19.2.3	Fluid to be handled	6 % w/w Lime Solution
19.2.4	Duty	Continuous and suitable for parallel operation.
19.2.5	Suction Condition	Flooded
19.2.6	Rated Capacity m ³ /hr for each	By bidder.
19.2.7	Tentative head to be developed at rated capacity, MLC	To be specified by the Supplier to meet the system requirements
19.2.8	Pump speed (RPM)	1500 maximum
19.2.9	Design Standard	As per Tender Specification
19.2.10	Design Temperature, °C	60
19.2.11	Range of Operation (%)	0 – 100
19.3	Material of construction	
19.3.1	All wetted parts	Cast iron to IS 210 FG 260
19.4	Type of drive	Electrical Motor
19.5	Instruments along with alarms, interlocks and accessories	To be provided as per the requirements of the Tender Specification and Drawings, enclosed with it



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19.6	Start and stop facility provided both at local and remote	To be provided in conjunction with Auto Start Facility
19.7	Trip interlock	To be provided
19.8	Accessories to be provided	
19.9	Pulsation Dampener	To be provided
19.10	Pressure Relief Valve	To be provided
20.	POLY ELECTROLYTE DOSING TANKS	
20.1	Numbers required	Two (2) (One working common for DM & for Non-DM and one as standby)
20.2	Description (applicable for each Tank)	
20.2.1	Type	Vertical rectangular with flat bottom
20.2.2	Type of fluid to be handled	0.5 % w/w Poly Electrolyte Solution
20.2.3	Effective capacity of each tank, m ³ /hr	Adequate to hold the quantity required for twelve (12) hours of operation of two (2) Clarifloculators.
20.2.4	Free Board, mm	300
20.2.5	Size	Bidder to indicate.
20.2.6	Design Pressure, Kg/cm ² (g)	As per Tender Specification.
20.2.7	Design Temperature, °C	60
20.2.8	Design Code	As per Tender Specification
20.2.9	Code for Test and Inspection	As per Tender Specification
20.3	Material of Construction	RCC
20.4	Protection	
20.4.1	Internal	5 mm thick jointless solvent free epoxy screed lining
20.4.2	External	Not applicable
20.5	Agitator along with drive motor and all other accessories	
20.5.1	(i) Number	One (1) per Tank
20.5.2	(ii) Material of Construction	SS 316
20.6	Dissolving Basket	
20.6.1	(i) Number	One (1) per Tank
20.6.2	(ii) Material of Construction	SS 316
20.7	Accessories	To be provided as per P&ID, enclosed with the Specification
20.8	Instruments	To be provided as per P&ID, enclosed with the Specification
21.	POLY ELECTROLYTE DOSING PUMPS	
21.1	Number	Two (1W+1S) for DM and Two (1W+1S) for Non-DM
21.2	Description for each Pump	

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21.2.1	Type of Pump	Positive displacement and hydraulic diaphragm type with stroke adjustment.
21.2.2	Location	Indoor.
21.2.3	Fluid to be handled	0.5 % w/w Poly Electrolyte Solution
21.2.4	Service	To dose Poly Electrolyte solution to the Clariflocculator
21.2.5	Duty	Continuous and suitable for parallel operation
21.2.6	Suction Condition	Flooded
21.2.7	Rated Capacity, m ³ /hr	By bidder.
21.2.8	Tentative head to be developed at rated capacity, MLC	To be specified by the Supplier to meet the system requirements
21.2.9	Design Standard	As per Tender Specification
21.2.10	Design Temperature, °C	60
21.2.11	Range of Operation (%)	0 – 100
21.2.12	Pump Speed, (RPM)	1500 maximum
21.3	Material of construction	
21.3.1	All wetted parts	SS-316
21.3.2	Diaphragm	PTFE
21.4	Type of drive	Electrical Motor
21.5	Instruments along with alarms, interlocks and accessories	To be provided as per the requirements of the Tender Specification and Drawings, enclosed with it
21.6	Start and stop facility provided both at local and remote	To be provided in conjunction with Auto Start Facility
21.7	Trip interlock	To be provided
21.8	Accessories to be provided	
21.9	Pulsation Dampener	To be provided
21.10	Pressure Relief Valve	To be provided
22.	GRAVITY FILTER	
22.1	NUMBER OF UNITS	Nine (Eight as working + one standby) for Non-DM; Two (2 x 100 %) for DM
22.2	Type	Rectangular Box type, twin bed
22.3	DESCRIPTION (applicable for each unit)	
22.3.1	Net continuous normal service flow rate, m ³ /hr	Gravity filters: 2x100% & capacity 100 M ³ /hr for each DM chain and Gravity filters: 9 nos.(8W+1S) & capacity 250 M ³ /hr for each non DM chain.
22.3.2	Time for each service cycle, hrs between two backwashes	24
22.3.3	Net guaranteed output in each service cycle, m ³ per day	43632 & 2400 respectively.



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22.4	FILTER DETAILS	
22.4.1	Design surface flow rate, m ³ /m ² /hr	5
22.4.2	Design Pressure Kg/cm ² (g)	Under atmospheric condition
22.4.3	Free Board over filtering media	Minimum 50%
22.4.4	Standing water depth over filter media	Minimum 2.0 metres
22.4.5	Free board with respect to water	500 mm (minimum) excluding slab thickness of operating floor above water level
22.5	WASH WATER GUTTERS	
22.5.1	Material of construction	RCC
22.5.2	Gutter spacing	Such that horizontal travel of backwash water does not exceed 1.0 m
22.5.3	Size	Adequate to carry all the backwash water delivered to it.
22.5.4	Required freeboards	(a) Minimum 50 mm between bottom of gutter and expanded sand
		(b) Minimum 50 mm between water surface in the gutter and gutter upper edge
22.6	WATER QUALITY	
22.6.1	Inlet turbidity considered for design, NTU	20
22.6.2	Turbidity of treated water, NTU	Less than 2
22.6.3	Filter media	
22.6.4	Type	Bed of graded sand supported over graded gravel
22.6.5	Bed depth of media, mm	Minimum 750 for sand, Minimum 450 for Gravel
22.7	CHARACTERISTICS OF MEDIA	
22.7.1	Grade	To be indicated by the Bidder
22.7.2	Bulk Density	1400-1600 kg/ m ³
22.7.3	Acid Solubility	Not to exceed 5% [10% HCl & 24 Hrs]
22.7.4	Effective size, mm	Effective size shall be 0.45 to 0.7 mm
22.7.5	Uniformity Coefficient	Shall not more than shall 1.7 nor less than 1.3.
22.7.6	Silica % (minimum)	Not less than 99.8
22.8	REGENERATION DETAILS	
22.8.1	Air Scour	Air from blowers with a suitable head at a minimum flow of 50 Nm ³ /hr/m ²
22.8.2	Backwashing facility	To be provided
22.8.3	Source and Quality	(a) From overhead Filter Backwash Water Tank



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		(b) Filtered Water
22.8.4	Flow	Backwash system shall be designed for maximum attainable temperature. Velocity shall not be less than 35 m/hr., when air scouring is employed. Average quantity of backwash water shall be limited to 2% to 3% of total filtered water produced between two (2) successive backwashes
22.8.5	Material of Construction	RCC
22.8.6	Code for Design	As per tender specification and applicable codes
22.8.7	Tests & Inspection	As per tender specification and applicable codes
22.9	INSTRUMENTATION	
22.9.1	Flow Indicator	
a.	Type	Float operated weir type primary element
b.	Number	One (1) for each unit
c.	Primary Element	Weir
d.	Location	At service outlet
22.9.2	Rate of flow Controller	
a.	Type	As per standard design, with slow start facility
b.	Number	One (1) for each unit
c.	Float material (if any)	G.I.
d.	Location	At service outlet
22.9.3	Loss of Head Indicator	
a.	Number	One per unit
b.	Location	Across the filter bed
23.	BLOWERS FOR GRAVITY FILTER, SLUDGE PIT & THICKENED SLUDGE SUMP	
23.1	Number of blowers required	Gravity Filter - Four (4), i.e. (1W+1S) for DM and (1W+1S) for Non-DM Sludge Pit – Two (2) (1W+1S) Thickened Sludge Sump - Two (2) (1W+1S)
23.2	Type	Twin lobe, oil free, rotary
23.3	Fluid to be handled	Ambient Air
23.4	Rated capacity (Nm ³ /hr)	Gravity Filter - Shall be suitable to meet air scouring operation of one (1) no. gravity filter with a rate not less than 50 Nm ³ /hr/m ² of filtration area. Sludge Pit and Thickened Sludge Sump – as per system requirement and tender specification.
23.5	Head to be developed at rated capacity, MWC	By the Bidder
23.6	Duty	Intermittent
23.7	Relief valve required	Yes
23.8	Design Temperature, °C	60
23.9	Design Code	As per Tender Specification & applicable codes
23.10	Test and Inspection	As per Tender Specification & applicable codes



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23.11	Suction filter, silencer & damper required	Yes
23.12	MATERIAL OF CONSTRUCTION	
23.13	Casing	CI [IS 210 - FG 260]
23.14	Lobe	CI [IS 210 - FG 260]
23.15	Shaft	Carbon Steel to EN 8 [BS - 970]
23.16	Type of drive	Electric Motors
23.17	Basis for selection of motor	While selecting the motor for pump, 15% (minimum) margin over BkW of pump at rated duty point shall be taken and standard motor with next higher KW rating available shall be selected. This shall in no way be less than maximum power required by pump.
23.18	Blower & Motor on common base plate	Required
23.19	INSTRUMENTATION	
13.19.1	Pressure gauge	
a.	Type	Ordinary with isolation valve
b.	Number	One (1) per blower
c.	Location	With pressure Snubber at Discharge
24.	GRAVITY FILTER HOUSE covered with RCC Roof	
24.1	Number	Two(2) ie one for DM and one for Non DM
24.2	Dimensions (Approximate)	As required to meet specification requirement.
25.	GRAVITY FILTER AIR BLOWER ROOM	
25.1	Number	One (1) accommodating air blowers for DM and Non DM applications
25.2	Location	At the ground floor of Gravity Filter House & shall be provided with RCC roof.
26.	SUITABLE ACCESSORIES	
26.1	Access ladder, platform, staircase, hand railings etc.	Shall be provided of structural steel.
26.2	Walkway	Shall be provided with hand railings around launder periphery of width 1200 mm.
26.3	Electrical requirements	For each Clariflocculator one (1) Distribution Board to be located on clarifier bridge for all drives of clarifier bridge assembly.
27.	CHEMICAL HOUSE	
27.1	Number	One (1).for Pre Treatment
27.2	Type	Two storied building of civil construction. (Civil construction by BHEL)
27.3	Building dimensions	As per requirement
27.4	Ground floor	Storage of chemical required for Alum, Lime and Poly Electrolyte dosing for 30 days storage capacity for PT Plant
27.5	First floor	Location of all chemical dosing tanks and pumps for entire PT Plant.
28.	WEIGHING SCALE FOR CHEMICAL	

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28.1	Type	Platform & dial type./electronic type
28.2	Number	Two (2) [One of 0-500 Kg & One (1) of 0-2000 Kg]
29.	HOIST	
29.1	Type	Electric operated with travelling trolley
29.2	Number	As per requirement
29.3	Capacity (each)	1 T
29.4	Design Standard	IS:3938 Class 2

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**SECTION-C2
(SPECIFIC TECHNICAL REQUIREMENT-ELECTRICAL)**

	TITLE: ELECTRICAL EQUIPMENT SPECIFICATION FOR PT PLANT SYSTEM BHUSAWAL TPS (1 X 660MW)	SPECIFICATION NO.
		VOLUME NO. : II-B
		SECTION: C
		REV NO. : 00 DATE: 02/07/2019
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C	SPECIFIC TECHNICAL REQUIREMENTS	1
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C	TECHNICAL SPECIFICATION FOR MOTORS	16
C	LV MOTOR (DATASHEET-A) ALONG WITH ANNEXURE-I (SUB VENDOR LIST)	2
D	GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	5
D	MOTOR DATASHEET-C	7
D	GENERAL TECHNICAL REQUIREMENTS FOR CONDUITS AND PIPES	6
D	CONSTRUCTIONAL DETAILS OF CABLES	3
D	QUALITY PLAN (FOR MOTORS BELOW 55 KW)	2
D	QUALITY PLAN (FOR MOTORS ABOVE & 55 KW)	9
D	LOAD DATA & CABLE LISTING FORMAT	4

	TITLE: ELECTRICAL EQUIPMENT SPECIFICATION FOR PT PLANT	SPECIFICATION NO.
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1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

- a) Services and equipment as per “Electrical Scope between BHEL and Vendor”.
- b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.
- c) Supply of mandatory spares as specified in the specifications of mechanical equipments.
- d) Electrical load requirement for PT PLANT SYSTEM.
- e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
- f) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer/BHEL approval without any commercial and delivery implications to BHEL.
- g) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc. shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.
- h) Motor shall meet minimum requirement of motor specification.
- i) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
- j) Cable BOQ worked out based on routing of cable listing provided by the vendor for “both end equipment in vendor’s scope” shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

2.0 EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:

Refer “Electrical Scope between BHEL and Vendor”.

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

- 3.1 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical/quality assurance requirements stipulated. In line with this, the bidder shall furnish two signed and stamped copies of the following:
 - a) A copy of this sheet “Electrical Equipment Specification for PT Plant Package and sheet Electrical scope between BHEL and Vendor” with bidder’s signature and company stamp.
 - b) Electrical load requirement in the load data format.
- 3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc. is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

4.0 List of enclosures:

- a) Electrical scope between BHEL & vendor (Annexure –I)
- b) Technical specification for motors DG/BSL U-6/2011/T-1
- c) Datasheets along with Annexure-I
- d) Conduit & Pipes specification & constructional details of cables.
- e) Quality plan for motors.
- f) Electrical Load data format (Annexure –II)
- g) BHEL cable listing format (Annexure –III)

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ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR**PACKAGE: PT PLANT****SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT****PROJECT: 1 X 660MW BHUSAWAL TPP**

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	1. 415 V AC (3 Phase, 4 Wire) /240 V AC supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	BHEL BHEL BHEL	BHEL Vendor BHEL	1. For 3.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Termination at BHEL equipment terminals by BHEL. 3. Termination at Vendor equipment terminals by Vendor.
4	Junction box for control & instrumentation cable	Vendor	Vendor	Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 10-12 mtrs) and trunk cable.
5	Any special type of cable like compensating, co-axial, prefab, MICC, fibre optical etc.	Vendor	Vendor	Refer C&I portion of specification for scope of fibre Optical cables if used between PLC/ microprocessor & DCS.
6	Cable trays, accessories & cable trays supporting system 100/ 50 mm cable trays/ Conduits/ Galvanised steel cable troughs for local cabling	BHEL Vendor	BHEL Vendor	Local cabling from nearby main route cable tray (BHEL scope) to equipment terminal (vendor's scope) shall be through 100/ 50 mm. cable trays/ conduits/ Galvanised steel cable troughs, as per approved layout drawing during contract stage.
7	Cable glands ,lugs and bimetallic strip for equipment supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power and control cables.
8	Conduit and conduit accessories for cabling between equipments supplied by vendor	Vendor	Vendor	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537.
9	Lighting	BHEL	BHEL	
10	Equipment grounding & lightning protection	BHEL	BHEL	Refer note no. 4 for electronic earthing
11	Below grade grounding	BHEL	BHEL	
12	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.
13	Mandatory spares	Vendor	-	Vendor to quote as per specification.

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ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR**PACKAGE: PT PLANT****SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT****PROJECT: 1 X 660MW BHUSAWAL TPP**

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
14	Recommended O & M spares	Vendor	-	As specified elsewhere in specification
15	Any other equipment/material/service required for completeness of system but not specified above (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
16	a) Input cable schedules (Control & Screened Control Cables) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable (excluding power cables) in enclosed excel format shall be submitted by vendor during detailed engineering stage.
17	Electrical Equipment & cable tray layout drawings	Vendor	-	For ensuring cabling requirements are met, vendor shall furnish Electrical equipment layout & cable tray layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipment requiring cabling, and shall incorporate cable trays routing details marked on the drawing as per PEM interface comments. Cabling arrangement of the same (wherever overhead cable trays, trenches, cable ducts, conduits etc.) shall be decided during contract stage. Electrical equipment layout & cable tray layout drawing shall be subjected to BHEL/ customer approval without any commercial implications to BHEL.
18	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

1. Make of all electrical equipment/ items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.
3. In case the requirement of Junction Box arises on account of Power Cable size mis-match due to vendor engineering at later stage, vendor shall supply the Junction Box for suitable termination.
4. Vendor shall indicate location of Electronic Earth pit in their Civil assignment drawing.

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1.0 <u>SCOPE</u> 1.1 This section covers the general requirements of the drive motors for power station auxiliary equipment. 1.2 Motors shall be furnished in accordance with both this general specification and the accompanying driven equipment specification. 1.3 In case of any discrepancy, the driven equipment specification shall govern etc. 2.0 <u>STANDARDS</u> 2.1 All motors shall conform to the latest applicable IS, IEC and CBIP Standards/ Publications except when otherwise stated herein or in the driven equipment specification. 2.2 Major standards, which shall be followed, are listed below other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed (a) IS-325 (b) IS-12615 (c) IEC-34 3.0 <u>SERVICE CONDITIONS</u> 3.1 The motors will be installed in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash canopy to be provided to all outdoor install motors. 3.2 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the annexure to this specification.		

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3.3	For motor installed outdoor and exposed to direct sunrays, the effect of solar heat shall be considered in the determination of the design ambient temperature	
4.0	<u>TYPE AND RATING</u>	
4.1	<u>A.C. MOTORS</u>	
4.1.1	Motors shall be general purpose, constant speed, squirrel cage, three phase, induction type.	
4.1.2	All motors shall be rated for continuous duty. They shall also be suitable for long period of inactivity.	
4.1.3	The motor name-plate rating at 50°C shall have at least 10% margin over the input power requirement of the driven HT equipment at rated duty point unless stated otherwise in driven equipment specification or in general electrical specification.	
4.1.4	The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service.	
4.1.5	All LT motors used in this project are proposed to be energy efficient type suitable for EFF1 efficiency rating.	
4.1.6	The motor name plate rating shall have at least 10% margin over the input power requirement of the HT driven equipment and 15% for LT driven equipments at rated duty point.	
4.1.7	Motors located in hazardous area shall be flame proof type.	
4.2	<u>D.C. MOTORS</u>	
4.2.1	D.C. Motor provided for emergency service shall be shunt/compound wound type.	
4.2.2	Motor shall be sized for operation with fixed resistance starter for maximum reliability.	

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4.2.3	Starter panel complete with all accessories shall be included in the scope of supply. 4.3 For equipment installed outdoor and exposed to direct sun rays, the effect of solar heat shall be considered in determining the design ambient temperature. 5.0 <u>PERFORMANCE</u> 5.1 <u>RUNNING REQUIREMENTS</u> 5.1.1 Motor shall run continuously at rated output over the entire range of voltage and frequency variations as given in the annexure. 5.1.2 The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals. 5.1.3 The motor shall be designed to withstand momentary overload of 60% of full load torque for 15 second without any damage. 5.1.4 Motor shall not be stalled if the supply voltage drops to 70% of the rated voltage for 2 seconds duration. 5.2 <u>STARTING REQUIREMENTS</u> Motor shall be designed for direct online starting at full voltage. Starting current shall not exceed 6 times full load current for all auxiliaries except boiler feed pump where the starting current shall be limited to 4.5 times. No further tolerances are applicable on starting current specified above for HT motors 5.2.1 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage 5.2.2 Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminal except BFP motor. In case of BFP motor, it shall	

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5.2.3	be 75% rated voltage. Minimum starting requirement for mill motor (double cage) shall be 85% rated voltage at motor terminals. Motor shall be capable of three equally spread starts per hour, two starts in quick succession from cold condition and one restart from hot condition. Cranking motor shall be capable of six equally spread starts per hour, three starts in quick succession from cold condition and one restart from hot condition. The coal conveyor and crusher motors shall be suitable for 3 consecutive hot starts with maximum 20 starts per day. Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with shaft rotating at 125% rated speed in reverse direction. HT pump motors shall be suitable to start with forward rotation. The motors shall be designed to withstand 120% of rated speed for 2 minutes without any mechanical damage <u>STRESS DURING BUS TRANSFER.</u> The motor may be subjected to sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage. The motor shall be designed to withstand any torsional and/or high current stresses, which may result, without experiencing any deterioration in the normal life and performance characteristics. <u>LOCKED ROTOR WITHSTAND TIME</u> The locked rotor withstand time under hot condition at 110% rated voltage shall be more than motor starting time by at least 2.5 seconds for motors up to 20 seconds starting time and by 5 seconds for motor with more than 20 seconds starting time.	

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5.4.2	Starting time mentioned above is at minimum permissible voltage of 80% rated voltage.	
5.4.3	Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting utilizing motor rated capacity	
6.0	<u>SPECIFIC REQUIREMENTS</u>	
6.1	<u>ENCLOSURE</u>	
6.1.1	All indoor motor enclosures shall conform to the degree of protection IP-55 unless otherwise specified and outdoor motor enclosure shall conform to degree of IPW-55. Motor for outdoor or semi-outdoor service shall be of weather-proof construction.	
6.1.2	For hazardous area approved type of increased safety enclosure shall be furnished.	
6.2	<u>COOLING</u>	
6.2.1	The motor shall be self ventilated type, either totally enclosed fan cooled (TEFC) or closed air circuit air- cooled (CACA).	
6.2.2	In case water cooling is required for very large motors, prior approval of the customer is to be obtained before proceeding ahead with design & manufacture.	
6.3	<u>WINDING AND INSULATION</u>	
6.3.1	All insulated winding shall be of copper.	
6.3.2	All motors shall have class F insulation but limited to class B temperature rise.	
6.3.3	Windings shall be impregnated to make them non-hygroscopic and oil resistant.	

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6.4 <u>TROPICAL PROTECTION</u> 6.4.1 All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion. 6.4.2 All fittings and hardwares shall be corrosion resistant. 6.5 <u>BEARINGS</u> 6.5.1 Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application. 6.5.2 Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred. 6.5.3 Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area. 6.5.4 Sleeve bearings shall be split type, ring oiled, with permanently aligned, close running shaft sleeves. 6.5.5 Grease lubricated bearings shall be prelubricated and shall have provisions for in-service positive lubrication with drains to guard against over lubrication. 6.5.6 Oiled bearing shall have an integral self cooled oil reservoir with oil ring inspection ports, oil sight glass with oil level marked for standstill and running conditions and oil fill and drain plugs. 6.5.7 Forced lubricated or water cooled bearing shall not be used without prior approval of Owner. 6.5.8 Lubricant shall not deteriorate under all service conditions. The lubricant shall be limited to normally available types with IOC equivalent. 6.5.9 Bearings shall be insulated as required to prevent shaft current and resultant bearing damage.		

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6.6	<u>NOISE & VIBRATION</u> 6.6.1 The noise level shall be as per statutory acceptance (IS/IEC). 6.6.2 The peak amplitude of the vibration shall be within IS/IEC specified limits. 6.7 <u>MOTOR TERMINAL BOX</u> 6.7.1 Motor terminal box shall be phase segregated (PSTB) type and located in accordance with Indian Standards clearing the motor base- plate/ foundation. 6.7.2 Terminal box shall be capable of being turned 360 Deg. in steps of 180 Deg. For HT motors and 90 Deg. for LT motors unless otherwise approved. 6.7.3 The terminal box shall be split type with removable cover with access to connections and shall have the same degree of protection as motor. 6.7.4 The terminal box shall have sufficient space inside for termination/connection of XLPE insulated armoured aluminium cables. 6.7.5 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame. 6.7.6 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor. 6.7.7 The terminal box shall be capable of withstanding maximum system fault current for duration of 0.25 sec. 6.7.8 For 11kV and 3.3kV motor, the terminal box shall be phase-segregated type. The neutral leads shall be brought out in a separate terminal box (not necessarily phase segregated type) with shorting links for star connection. 6.7.9 Motor terminal box shall be furnished with suitable cable lugs and double compression brass glands to match with cable used. 6.7.10 The gland plate for single core cable shall be non-magnetic type.	

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6.7.11 Due to any reason, if the terminal box is found to be not suitable for the approved cable size for either HT/LT motors, then the bidder shall arrange necessary adopter box to facilitate the termination of cables. The adopter box shall be of the same short circuit rating and specifications as the main terminal box. The adopter box shall be located as near as possible to the main terminal box. The interconnecting cabling between adopter box and main terminal box along with providing suitable cable glands and termination kits as applicable shall also be done by the bidder.

6.8 GROUNDING

6.8.1 The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GS bolts and washer

6.8.2 The grounding connection shall be suitable for accommodation of ground conductors as follows :

Motor above 90 kW : 75 x 10 mm GS Flat

Motor above 30 kW up to 90 kW : 50 x 6 mm GS Flat

Motor above 5 kW up to 30 kW : 25 x 6 mm GS Flat

Motor up to 5 kW : 8 SWG GS Wire

6.8.3 The cable terminal box shall have a separate grounding pad

6.9 RATING PLATE

In addition to the minimum information required by IS, the following information shall be shown on motor rating plate:

(a) Temperature rise in Deg.C under rated condition and method of measurement.

(b) Degree of protection.

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(c) Bearing identification no. and recommended lubricant. (d) Location of insulated bearings. 6.10 <u>CONSTRUCTION</u> 6.10.1 Stator Core The Stator Core Lamination shall be made of high-grade silicon/magnetic steel sheet varnished on both sides and pressed to form rigid core. 6.10.2 Rotor The rotor construction shall be such that in case of dislodging of the rotor bar from the end ring, it should not come out and hit the stator core/stator winding and damage. 7.0 <u>ACCESSORIES</u> 7.1 <u>GENERAL</u> Accessories shall be furnished, as listed below, or if otherwise required by driven equipment specification or application 7.2 <u>SPACE HEATER</u> 7.2.1 Motor of rating 30 kW and above shall be provided with space heaters, suitably located for easy removal or replacement. 7.2.2 The space heater shall be rated 240 V, 1 phase 50 Hz and sized to maintain the motor internal temperature above dew point when the motor is idle. 7.3 <u>TEMPERATURE DETECTORS</u> 7.3.1 All 11kV and 3.3kV motors shall be provided with twelve (12) nos. Simplex type winding temperature detectors, four (4) nos. per phase.		

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7.3.2	11kV and 3.3kV motor bearing shall be provided with duplex type temperature detectors.	
7.3.3	The temperature detector mentioned above shall be resistance type, 3 wire, platinum wound, 100 Ohms at 0°C.	
7.3.4	Leads of all simplex type motor winding RTDS and motor bearing RTDS shall be wired up to respective switchgear metering & protection compartment. From which one set of RTDS will be connected to numerical protection relay and another set shall be kept free for DCS connectivity.	
7.3.5	Five numbers of Temperature detectors / thermistors shall be provided for L.T. Motors above 90 kW (3 nos. Winding temperatures & 2 nos. bearing temperatures).	
7.4	<u>INDICATOR/SWITCH</u>	
7.4.1	Dial type local indicator with alarm contacts shall be provided for the following :	
	(a) 11kV and 3.3kV motor bearing temperature	
	(b) Hot and cold air temperature of the closed air circuit for CACA and CACW motor	
7.4.2	Flow switches shall be provided for monitoring cooling water flow of CACW motor and oil flow of forced lubrication bearing, if used.	
7.4.3	Alarm switch contact rating shall be minimum 0.5 A at 220V D.C. and 5A at 240V A.C.	
7.5	<u>CURRENT TRANSFORMER FOR DIFFERENTIAL PROTECTION</u>	
7.5.1	Motor 1000 KW and above shall be provided with three differential current transformers mounted over the neutral leads within the enclosure. Loose 3 nos. CT for mounting on switchgear side shall be in bidder's scope.	

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7.5.2	The arrangement shall be such as to permit easy access for C.T. testing and replacement. Current transformer characteristics shall match Owner's requirements to be intimated later.	
7.6	<u>ACCESSORY TERMINAL BOX</u>	
7.6.1	All accessory equipment such as space heater, temperature detector, current transformers etc., shall be wired to and terminated in terminal boxes, separate from and independent of motor (power) terminal box.	
7.6.2	Accessory terminal box shall be complete with double compression brass glands and pressure type terminals to suit cable connections.	
7.7	<u>DRAIN PLUG</u> Motor shall have drain plugs so located that they will drain the water, resulting from the condensation or other causes from all pockets of the motor casing.	
7.8	<u>LIFTING PROVISIONS</u> Motor weighing 25 Kg. or more shall be provided with eyebolt or other adequate provision of lifting.	
7.9	<u>DOWEL PINS</u> The motor shall be designed to permit easy access for drilling holes through motor feet or mounting flange for installation of dowel pins after assembling the motor and driven equipment.	
7.10	<u>PAINTING</u> Motor including fan shall be painted with corrosion proof paints of colour shade (RAL-7032).	
8.0	<u>TESTS</u>	
8.1	<u>ROUTINE AND TYPE TEST:</u>	

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Tests are to be conducted for HT and LT motors 60kW and above in presence of Mahagenco representative and contractor as per IS: 325 and required copies of test certificates are to be furnished for approval and despatch clearance. In addition, following tests shall have to be carried out on the motors in presence of MAHAGENCO representative & contractor on LT & HT motors. For Motors below 60kW type and routine test conducted as per IS325 shall be witnessed by contractor and test certificate shall be submitted for review of Mahagenco & Dispatch clearance

8.1.1 FOR HT MOTORS:

(a) Impulse test by 1.2 / 50 micro sec. On sample coil of Stator winding insulation as type test as per IEC-671/IS 14422,1995 test voltages as under

Voltage rating of motor	Impulse Test Voltage
3.3 kV	: 18 kV peak
11 kV	: 49 kV peak

(b) Tan delta, charging current and dielectric loss measurements on each phase of motor stator winding as routine test

(c) Polarization Index Test as per IS:7816 as routine test

(d) Tan delta measurement on coils

(e) Surge withstand test for inter turn insulation.

(f) Test to diagnose rotor bar failure during manufacture.

Tests indicated at (d), (e), (f) shall be carried out during manufacture of the coils and shall be furnished for verification .

8.1.2 FOR HT & LT MOTORS:

(a) Test for suitability of IP55/ IPW– 55 as per IS 4691 as type test. Type test certificate for first numeral shall be acceptable in lieu to test,

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provided the test motor is identical to motor being supplied. Second numeral test shall be carried out on one motor of each type and rating. (b) Fault Withstand Test for main terminal box as type test. Type test certificate shall be acceptable, if the test is conducted on exactly identical terminal box within last three years. (c) Test for noise level as routine test. (d) Test for vibration as routine test. (e) Overspeed test as type test. 8.2 <u>TEST WITNESS:</u> Test shall be performed in presence of Owner/Purchaser's representative so desired by the Owner/Purchaser. The Contractor shall give at least fifteen (15) days advance notice of the date when the tests are to be carried out.		

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<u>AC & DC MOTOR</u>			
SR. NO.	ITEM	UNIT	
1.0	<u>AUXILIARY POWER SUPPLY</u>		
1.1	<u>H.T. SUPPLY</u>		
	11kV, 3Ø, 3W, 50 Hz non-effectively earthed		Motors rated 1000 kW and above
	Fault level 44 kA symm		
	3.3kV, 3Ø, 3W, 50 Hz, non-effectively earthed		Motors above 160 kW and below 1000kW
	Fault level 40 kA symm		
1.2	<u>L.T. SUPPLY</u>		
	415V, 3Ø, 3W, 50 Hz effectively earthed		Motors below and including 160kW
	Fault level 50 kA symm		
	240V, 1Ø, 2W, 50 Hz effectively earthed		Lighting, space heating, A.C. control & protective devices
1.3	<u>D.C. SUPPLY</u>		
	220V, 2W, unearthed		D.C. alarm, control & protective devices
	Fault level 25* kA.		
	Indicative only, the actual value will be decided by the Bidder, after substantiating the same by calculation		
2.0	<u>RANGE OF VARIATION</u>		

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SR. NO.	ITEM	UNIT	
2.1	<u>A.C. SUPPLY:</u>		
	Voltage		± 10%
	Frequency		± 5%
	Combined Voltage & frequency		± 10% (absolute sum)
	During starting of large motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance		
2.2	<u>D.C. SUPPLY</u>		
	Voltage		198 to 240 Volt

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TITLE

LV MOTORS DATA SHEET-A

1X660 MW BHUSAWAL TPP

SPECIFICATION NO.

VOLUME II B

SECTION

D

REV NO. 00

DATE

02.07.2019

SHEET 1

OF

1

- | | | | |
|------|---|---|---|
| 1.0 | Design ambient temperature | : | 50 °C |
| 2.0 | Maximum acceptable kW rating of LV motor | : | 160KW |
| 3.0 | Installation (Indoors/ Outdoors) | : | As required |
| 4.0 | Details of supply system | | |
| a) | Rated voltage (with variation) | : | 415V $\pm$ 10% |
| b) | Rated frequency (with variation) | : | 50 Hz (+5% and -5%) |
| c) | Combined voltage & freq. variation | : | 10% (sum of absolute values) |
| d) | System fault level at rated voltage | : | 50 kA for 1 sec |
| e) | Short time rating for terminal boxes | : | |
| | o 90 kW and upto 160kW (Breaker controlled) | : | 50 KA for 1 sec. |
| | o Below 90 kW (SFU + Contactor controlled) | : | 50 KA protected by fuse for 0.2 sec |
| f) | LV System grounding | : | Effectively grounded |
| 5.0 | Class of insulation | : | Class 'F', with temp rise limited to class B. |
| 6.0 | Minimum voltage for starting (As percentage of rated voltage) | : | 80% of rated voltage |
| 7.0 | Power cables data | : | Shall be given during Detailed engg |
| 8.0 | Earth Conductor Size & Material | : | Shall be given during Detailed engg |
| 9.0 | Space heater supply | : | 240 V, 1 ϕ , 50 Hz |
| 10.0 | Rating up to which Single phase motor | : | Acceptable below 0.20 kW |
| 11.0 | Additional tests | : | As per QP and customer motor spec |
| 12.0 | Flame-proof motor | | |
| a) | Enclosure suitable (As per IS:2148) | : | As per requirement |
| b) | Classification of Hazardous area (As per IS: 5572 part-I) | : | As per requirement |
| 13.0 | Makes | : | As per ANNEXURE-I |
| 14.0 | Paint shade | : | RAL 7032 |
| 15.0 | Degree of Protection of enclosure (motors): | : | INDOOR IP-55
OUTDOOR IPW-55 |
| 16.0 | Energy efficiency | : | IE3 as per IS:12615: 2011 |

❖ Also detail Customer spec. for Motors to be referred as enclosed with spec.

ANNEXURE-I

SUB-VENDOR LIST

The list of approved make of the LT Motors are as mentioned below:

S.No.	LIST OF LT MOTORS
1.	BHARAT BIJLEE LTD.
2.	CROMPTON GREAVES
3.	ASEA BROWN BOVERI
4.	KIRLOSKAR ELECTRIC CO LTD.
5.	NGEF
6.	SIEMENS
7.	MARATHON
8.	GE-POWER
9.	RAJINDRA ELECT INDUSTRIES
10.	LAXMI HYDRAULICS PVT. LTD

However, the final list of makes for the LT Motors is subjected to BHEL/Customer approval, during contract stage, without any commercial implications.

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101 VOLUME NO. : II-B
		REV NO. : 00 DATE : 29/08/2005 SHEET : 1 OF 1

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.: PE-SS-999-506-E101 Rev 00

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101																														
		VOLUME NO. : II-B																														
		SECTION : D																														
		REV NO. : 00 DATE : 29/08/2005																														
		SHEET : 1 OF 4																														
1.0 INTENT OF SPECIFIATION The specification covers the design, materials, constructional features, manufacture, inspection and testing at manufacturer’s work, and packing of Low voltage (LV) squirrel cage induction motors along with all accessories for driving auxiliaries in thermal power station. Motors having a voltage rating of below 1000V are referred to as low voltage (LV) motors.																																
2.0 CODES AND STANDARDS Motors shall fully comply with latest edition, including all amendments and revision, of following codes and standards: <table><tr><td>IS:325</td><td>Three phase Induction motors</td></tr><tr><td>IS : 900</td><td>Code of practice for installation and maintenance of induction motors</td></tr><tr><td>IS: 996</td><td>Single phase small AC and universal motors</td></tr><tr><td>IS: 4722</td><td>Rotating Electrical machines</td></tr><tr><td>IS: 4691</td><td>Degree of Protection provided by enclosures for rotating electrical machines</td></tr><tr><td>IS: 4728</td><td>Terminal marking and direction of rotation rotating electrical machines</td></tr><tr><td>IS: 1231</td><td>Dimensions of three phase foot mounted induction motors</td></tr><tr><td>IS: 8789</td><td>Values of performance characteristics for three phase induction motors</td></tr><tr><td>IS: 13555</td><td>Guide for selection and application of 3-phase A.C. induction motors for different types of driven equipment</td></tr><tr><td>IS: 2148</td><td>Flame proof enclosures for electrical appliance</td></tr><tr><td>IS: 5571</td><td>Guide for selection of electrical equipment for hazardous areas</td></tr><tr><td>IS: 12824</td><td>Type of duty and classes of rating assigned</td></tr><tr><td>IS: 12802</td><td>Temperature rise measurement for rotating electrical machines</td></tr><tr><td>IS: 12065</td><td>Permissible limits of noise level for rotating electrical machines</td></tr><tr><td>IS: 12075</td><td>Mechanical vibration of rotating electrical machines</td></tr></table> In case of imported motors, motors as per IEC-34 shall also be acceptable.			IS:325	Three phase Induction motors	IS : 900	Code of practice for installation and maintenance of induction motors	IS: 996	Single phase small AC and universal motors	IS: 4722	Rotating Electrical machines	IS: 4691	Degree of Protection provided by enclosures for rotating electrical machines	IS: 4728	Terminal marking and direction of rotation rotating electrical machines	IS: 1231	Dimensions of three phase foot mounted induction motors	IS: 8789	Values of performance characteristics for three phase induction motors	IS: 13555	Guide for selection and application of 3-phase A.C. induction motors for different types of driven equipment	IS: 2148	Flame proof enclosures for electrical appliance	IS: 5571	Guide for selection of electrical equipment for hazardous areas	IS: 12824	Type of duty and classes of rating assigned	IS: 12802	Temperature rise measurement for rotating electrical machines	IS: 12065	Permissible limits of noise level for rotating electrical machines	IS: 12075	Mechanical vibration of rotating electrical machines
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IS: 12065	Permissible limits of noise level for rotating electrical machines																															
IS: 12075	Mechanical vibration of rotating electrical machines																															
3.0 DESIGN REQUIREMENTS 3.1 Motors and accessories shall be designed to operate satisfactorily under conditions specified in data sheet-A and Project Information, including voltage & frequency variation of supply system as defined in Data sheet-A 3.2 Motors shall be continuously rated at the design ambient temperature specified in Data Sheet-A and other site conditions specified under Project Information Motor ratings shall have at least a 15% margin over the continuous maximum demand of the driven equipment, under entire operating range including voltage & frequency variation specified above. 3.3 Starting Requirements 3.3.1 Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% higher than that of the driven equipment. 3.3.2 Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.																																

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 2 OF 4
The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value as per Data Sheet - A during the starting period of motors.		
3.3.3 The following frequency of starts shall apply i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature. ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour) iii) Motors for coal conveyor and coal crusher application shall be suitable for three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable for minimum 20,000 starts during the life time of the motor		
3.4 Running Requirements		
3.4.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.		
3.4.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 2 secs.		
3.5 Stress During bus Transfer		
3.5.1 Motors shall withstand the voltage, heavy inrush transient current, mechanical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.		
3.5.2 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.		
3.6 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.		
3.7 The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.		
4.0 CONSTRUCTIONAL FEATURES		
4.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691 and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy		
4.2 Motors upto 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362.		
Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled		
4.3 Motors shall be designed with cooling fans suitable for both directions of rotation.		

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4.4.	Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.	
4.5	Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.	
4.6	In case Class ‘F’ insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class ‘B’ insulation. In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.	
4.7	Terminals and Terminal Boxes	
4.7.1	Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A. Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet “A”.	
4.7.2	unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.	
4.7.3	Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or U W & V respectively.	
4.7.4	Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.	
4.7.5	Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.	
4.7.6	Degree of protection for terminal boxes shall be IP 55 as per IS 4691.	
4.7.7	Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.	
4.7.8.	Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.	
4.7.9	Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.	
4.8	Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.	
4.9	General	

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4.9.1 Motors provided for similar drives shall be interchangeable. 4.9.2 Suitable foundation bolts are to be supplied alongwith the motors. 4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above. 4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956. 4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz. 4.9.6 Name plate with all particulars as per IS: 325 shall be provided 4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions. 5.0 INSPECTION AND TESTING 5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied. 5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser. 5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan. 5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A. 6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT a) OGA drawing showing the position of terminal boxes, earthing connections etc. b) Arrangement drawing of terminal boxes. c) Characteristic curves: (To be given for motor above 55 kW unless otherwise specified in Data Sheet). i) Current vs. time at rated voltage and minimum starting voltage. ii) Speed vs. time at rated voltage and minimum starting voltage. iii) Torque vs. speed at rated voltage and minimum voltage. For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling. iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.		

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LT MOTORS**A. GENERAL**

1. Manufacturer & Country of origin.
(Shall be as per approved QA make)
2. Equipment driven by motor
3. Motor type
4. Quantity

B. DESIGN AND PERFORMANCE DATA

1. Frame size
2. Type of duty
3. Type of enclosure /Method of cooling/Degree of protection
4. Applicable standard to which motor generally conforms
5. Efficiency class as per IS 12615
6. (a) Whether motor is flame proof Yes/No
(b) If yes, the gas group to which it conforms as per IS:2148
7. Type of mounting
8. Direction of rotation as viewed from DE END__
9. Standard continuous rating at 40 deg.C. ambient temp. as per Indian Standard (KW)
10. Derated rating for specified normal condition i.e. 50 deg. C ambient temperature (KW)
11. Maximum continuous load demand of driven equipment in KW
12. Rated Voltage (volts)
13. Permissible variation of :

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- a. Voltage (Volts)
 - b. Frequency (Hz)
 - c. Combined voltage and frequency
14. Rated speed at rated voltage and frequency(RPM)
15. At rated Voltage and frequency:
 - a. Full load current
 - b. No load current
16. Power Factor at
 - a. 100% load
 - b. NO load
 - c. Starting.
17. Efficiency at rated voltage and frequency,
 - a. 100% load
 - b. 75% load
 - c. 50% load
18. Starting current (amps) at
 - a. 100 % voltage
 - b. 85% voltage
 - c. 80% voltage
19. Minimum permissible starting Voltage (Volts)
20. Starting time with minimum permissible voltage
 - a. Without driven equipment coupled
 - b. With driven equipment coupled

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21. Safe stall time with 100% and 110% of rated voltage
 - a. From hot condition
 - b. From cold condition
22. Torques :
 - a. Starting torque at min. permissible voltage(kg-mtr.)
 - b. Pull up torque at rated voltage.
 - c. Pull out torque
 - d. Min accelerating torque (kg.m) available
 - e. Rated torque (kg.m)
23. Stator winding resistance per phase (ohms at 20 Deg.C.)
24. GD^2 value of motors
25. No of permissible successive starts when motor is in hot condition
26. Locked Rotor KVA Input
27. Locked Rotor KVA/KW
28. Vibration limit :Velocity (mm/s)
29. Noise level limit (dBA)

C. CONSTRUCTIONAL FEATURES

1. Stator winding insulation
 - a. Class & Type
 - b. Winding Insulation Process
 - c. Tropicalised (Yes/No)

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- d. Temperature rise over specified maximum ambient temperature of 50 deg C
 - e. Method of temperature measurement
 - f. Stator winding connection
2. Main Terminal Box
 - a. Type
 - b. Location (viewed from NDE side)
 - c. Entry of cables(bottom/side)
 - d. Recommended cable size (To be matched with cable size envisaged by owner)
 - e. Fault level (MVA), Fault level duration (sec)
 - f. Cable glands & lugs details (shall be suitable for power cable)
3. Type of DE/NDE Bearing
4. Motor Paint shade
5. Weight of
 - a. Motor stator (KG)
 - b. Motor Rotor (KG)
 - c. Total weight (KG)

D. List of accessories.

1. Space Heaters (Applicable for 30 KW & above motor)
(Nos./Power in watts/supply voltage)
2. Terminal Box for Space Heater (Yes/No)
3. Speed switch (Yes/No)
No of contacts and contact ratings of speed switch

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4. Insulation of bearing (Yes/No)

5. Noise reducer(Yes/No)

6. Grounding pads

i) No and size on motor body

ii) Nos on terminal Box

7. Vibration pads

i) Nos and size

ii) Location

8. Any other fitments

E. List of curves.

1. Torque speed characteristic of the motor

2. Thermal withstand characteristic

3. Starting. current Vs. Time

4. Starting. current Vs speed

5. P.F. and Effi. Vs Load

F. Additional Data to be filled for each rating of DC Motor

1. Rated armature voltage (Volt)

2. Rated field excitation (Amp)

3. Permissible % variation in voltage

4. Minimum Permissible Starting voltage (volt)

5. At rated voltage

i) Full load Armature current.(Amp)

ii) Full load Field current (Amp)

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- iii) No load Armature current (Amp)
6. Full load Field current (Amp)
7. No load Armature current (Amp)
8. Minimum permissible field current(Amp) to avoid overspeeding at
 - i) Maximum permissible voltage
 - ii) Rated voltage
 - iii) Minimum Permissible Voltage
9. Resistance (indicative Values) in ohm
 - i) Armature winding (Arm + IP + Series) at 25 deg.C
 - ii) Field Winding at 25 deg. C
10. Inductance (indicative values)
 - i) Armature winding
 - ii) Field winding
11. Value of trimmer resistance (ohm) to be connected in series with the shunt field to obtain rated speed at
 - i) 220 V DC
 - ii) 250 V DC
 - iii) 187 V DC
12. Value of the external resistance (ohm) required to be connected in series with armature during starting only
13. Technical data sheet for external resistance box
14. GA drawing of motor
15. Starting time calculation

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16. Starter resistance design calculation
17. Electrical connection diagram of motor

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DOCUMENT TITLE

CONDUITS AND PIPES

SPECIFICATION NO. PES-507-27

VOLUME II B

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**GENERAL TECHNICAL REQUIREMENTS
OF
CONDUITS AND PIPES
SPECIFICATION NO. PES-507-27
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1.0 GENERAL

- 1.1 This specification covers the manufacture, inspection & testing at vendor's works and delivery to site of conduits, pipes and their fittings for electrical installation.

2.0 CODES AND STANDARDS

- 2.1 The material, constructional features and various processes involved in manufacture shall comply with currently applicable Indian Standards.
- 2.2 The following Indian Standards shall be applicable, in general. However if Data Sheet A specifies conformance to other international standards, the equivalent IEC/BS/other standards shall be considered.

- a) IS:9537 (All Parts) Conduits for electrical installation.
- b) IS:3480 Flexible steel conduits for electrical wiring.
- c) IS:6946 Flexible non-metallic conduits for electrical installation.
- d) IS:1239 Mild steel tubes, tubulars and other wrought steel fittings.
(for size above 63mm dia of rigid conduits)
- e) IS:2667 Fittings for rigid steel conduits for electrical wiring.
- f) IS:3837 Accessories for rigid steel conduits for electrical wiring.
- g) IS:3419 Fittings for rigid non-metallic conduits.
- h) IS:6005 Code of practice for phosphating iron & steel.
- i) IS:2629 Recommended practice for hot dip galvanizing on iron and steel.
- j) IS:4759 Specification for hot dip zinc coatings on structural steel and allied products.
- k) IS:6745 Methods for determination of mass of zinc coating on zinc coated iron and steel articles.

3.0 DESIGN REQUIREMENTS AND CONSTRUCTIONAL FEATURES

The conduit and conduit accessories shall include conduit plugs & caps, gaskets and box cover etc in addition to any specific requirement given in Data Sheet A. The diameter of conduits and accessories shall be uniform throughout the length.

3.1 Rigid Conduits and Fittings

- 3.1.1 Rigid conduits shall generally conform to the requirements of IS:9537 (Part I & Part II). However conduits above 63mm diameter shall conform to the requirements of IS:1239. Unless specified otherwise in Data Sheet A, all conduits and pipes shall be of medium duty.

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- 3.1.2 The rigid conduits shall be hot dip galvanized inside and outside. Weight of zinc shall be as per IS:4759. Conduits shall be thoroughly cleaned and pretreated, conforming to IS:6005.
- 3.1.3 Conduits shall be supplied in approximate length as specified below
- a) Rigid Conduits 5 metres
 - b) Flexible Conduits 10 - 30 metres
- 3.1.4 Each end of conduit length shall be threaded. The ends of conduits shall be sealed with protective caps to prevent damage to threaded portions and entrance of moisture and foreign material.
- 3.1.5 The inside surface of all conduits shall be smooth and suitable for pulling insulated cables and wires without damage.
- 3.1.6 Conduit fittings shall be made out of tube or cast to the shape as to match with corresponding conduit sizes and meet their purpose without any special adjustment.
- 3.1.7 All fittings shall be screwed type and hot dip galvanized inside and outside.
- 3.2 Flexible Metallic Conduits and Fittings
- 3.2.1 Flexible metallic conduits shall generally conform to the requirements of IS:3480.
- 3.2.2 Flexible conduits shall be made of strip steel which shall be of cold rolled mild steel. The strip shall be of uniform width and thickness throughout.
- 3.2.3 The strip shall be electro galvanized to a minimum thickness of 25 microns as specified in IS:3480. The surface of the strip shall be thoroughly cleaned before application of protective coating. Pretreatment, before galvanization, shall conform to IS:6005.
- 3.2.4 The strip for making flexible conduit shall be wound tightly and so overlapped in subsequent helicals that no openings are seen in normal position.
- 3.2.5 Flexible conduits shall be lead coated for application in high temperature zones, if specifically mentioned in Data Sheet A.
- 3.2.6 The conduit shall have uniform diameter throughout its length. The internal surface of all conduits shall be smooth and suitable for pulling insulated cables and wires without damage.
- 3.3 PVC Conduits
- 3.3.1 PVC conduits shall generally conform to the requirements of IS:9537(Part I & Part III).
- 4.0 INSPECTION
- 4.1 The following stages of manufacture shall be stage inspected by Purchaser or his duly authorized representative.
- 4.1.1 Inspection of manufacturing processes such as shearing, punching, bending, welding, galvanizing etc.
 - 4.1.2 Inspection of packing material and procedure.

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4.1.3 Inspection of finished product.

4.2 The inspection will be carried out as per agreed quality plan.

5.0 TESTING

5.1 Rigid Conduits

- a) Acceptance Tests
 - as per IS:9537 Part 1 & 2 upto 63mm OD
 - as per IS:1239 above 63mm OD
- i) Dimension checks
 - ii) Bending test (below 32mm OD)
 - iii) Compression test
- b) Special Tests (as acceptance test) as applicable to galvanizing.

5.2 Flexible Steel Conduits

- a) Acceptance Tests
 - as per IS:3480
- i) Dimension checks
 - ii) Linear breaking test
 - iii) Test for flexibility
 - iv) Bend fracture test
 - v) crushing test
- b) Special Tests (as acceptance test) as applicable to galvanizing.

5.3 PVC Conduits

- a) Type Tests
 - as per IS : 9537 (Part 1 & 3)
- i) Dimension checks
 - ii) Bending test
 - iii) Compression test
 - iv) Impact test
 - v) Collapse test
 - vi) Resistance test
 - vii) Resistance to burning

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viii) Electrical Characteristics

b) Acceptance tests - as per IS:9537 (Part 1 & 3)

i) Dimension checks

ii) Bending test

iii) Compression test

iv) Collapse test

v) Resistance to burning

vi) Electrical characteristics

5.4 Sampling for the tests shall be done as per applicable standards mentioned above.

5.5 The testing shall be carried out as per agreed quality plan.

6.0 PACKING

6.1 The material shall be packed as per manufacturer's standard. Packing procedure shall be to the purchaser's approval.

7.0 DRAWING, DATA AND DOCUMENTS REQUIRED

7.1 The following information shall be furnished within two weeks of award of contract, for purchaser's approval.

a) Manufacturing drawings/details.

b) Recommended Field quality plan covering site handling, storing, laying etc.

c) Final quality plan.

7.3 The following information shall be furnished after testing and inspection

Type Test, routine test and special test certificates in bound volume in requisite number.

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DATASHEET A

SPECIFIC TECHNICAL REQUIREMENTS

- 1.0 APPLICABLE STANDARDS: IS:9537,IS: 1239, IS:3480
- 2.0 RIGID STEEL CONDUITS & STEEL PIPES
- a) Material: Cold rolled mild steel to IS:226
 - b) Applicable standard
 - i) Upto 63mm OD: IS:9537 Part I & II
 - ii) Above 63mm OD: IS:1239
 - c) Surface treatment: Hot dip galvanizing inside & outside as per IS:2629
 - d) Wt. of zinc: as per IS 4759
 - e) Duty: Medium
 - f) Fittings: Screw type as per IS:2667
- 3.0 FLEXIBLE CONDUITS:
- a) Material: Strip steel cold rolled and annealed
 - b) Standard applicable: IS: 3480
 - c) Surface treatment: Electro galvanized as per IS: 3480
 - d) Whether lead coated: YES
 - e) Minimum thickness: 25 microns
of zinc coating
- 4.0 PVC CONDUITS
- a) Material: PVC
 - b) Applicable standard: IS: 9537 (Part I & III)

	Design Calculations For LT Cable Selection & Sizing	
	1 x 660MW BHUSAWAL T.P.S UNIT-6	

CONSTRUCTIONAL DETAILS OF CABLES SELECTED**(A) LT POWER & CONTROL CABLES**

S.NO.	PARTICULARS	DETAILS	
		LT POWER CABLES	LT CONTROL CABLES
1	REFERENCE STANDARD	IS: 7098 -PART -1	IS -1554 PART -1
2	SYSTEM	415 V AC , 240 V AC & 220V DC	220V DC & 110 V AC
3	VOLTAGE GRADE	1.1 KV	1.1 KV
4	CONDUCTOR		
4.1	MATERIAL	STRANDED COMPACTED PLAIN ALUMINIUM CONDUCTOR OF H2 GRADE CLASS 2 / STRANDED HIGH CONDUCTIVITY ANNEALED PLAIN COPPER.	STRANDED,NON COMPACTED, HIGH CONDUCTIVITY ANNEALED PLAIN COPPER
4.2	REFERENCE STANDARD	IS 8130	IS 8130
4.3	SHAPE	CIRCULAR/ SHAPED	CIRCULAR
4.4	MINIMUM SIZE	ALUMINIUM- 16 SQ.MM. COPPER- 2.5 SQ. MM.	2.5 SQ.MM.
4.5	MAXIMUM CONDUCTOR TEMPERATURE WHEN CARRYING CONTINUOUSLY CURRENT	90°C	70°C
4.6	MAXIMUM CONDUCTOR TEMPERATURE AT THE TERMINATION OF SHORT CIRCUIT CURRENT	250°C	160°C
5	NO. OF CORES	1C,2C,3C,3.5C,4C	AS PER CLAUSE 4.2.1
6	INSULATION	EXTRUDED XLPE	EXTRUDED HRPVC, TYPE-C
6.1	REFERENCE STANDARD	IS: 7098 -PART -1	IS -5831 & IS-1554 PART-I
7	CORE IDENTIFICATION	BY COLOR CODING AS PER IS: 7098 -PART -1	i) CONTROL CABLES UPTO 5 CORE- COLOR CODING AS PER IS 1554 (Part-1) (ii) CONTROL CABLES ABOVE 5 CORES- BY NUMBERING AS PER IS 1554 (Part-1). INSULATION TO HAVE BLACK COLOR.
8	INNER SHEATH	EXTRUDED HRPVC FRLS TYPE -ST2 FOR MULTI CORE CABLES. SINGLE CORE SHALL HAVE NO INNER SHEATH.	EXTRUDED HRPVC TYPE -ST2 FRLS FOR MULTI CORE CABLES. SINGLE CORE SHALL HAVE NO INNER SHEATH.
8.1	REFERENCE STANDARD	IS: 5831 & IS-7098 PART-I	IS: 5831 & IS-1554 PART I
9	ARMOUR	NON-MAGNETIC HARD DRAWN ALUMINIUM ROUND WIRE ARMOUR OF H4 GRADE FOR SINGLE CORE CABLES AND GS ROUND STEEL WIRE ARMOUR FOR MULTI- CORE CABLES	GS ROUND STEEL WIRE ARMOUR FOR TWIN & MULTICORE CABLES
9.1	REFERENCE STANDARD	IS:3975 & IS 7098 PART I	IS 3975 & IS-1554 PART I
10	OUTER SHEATH	EXTRUDED FRLSH HRPVC TYPE ST2	EXTRUDED FRLSH HRPVC TYPE ST2
10.1	REFERENCE STANDARD	IS: 5831 & IS-7098 PART-I	IS: 5831
11	MARKING	(i) CABLE SIZE (CROSS SECTION AREA AND NO. OF CORES, VOLTAGE GRADE, WORD 'FRLS', REF. IS, TYPE OF CABLE, TYPE OF INSULATION/ SHEATH, MANUFACTURER'S NAME AND/OR TRADE NAME, YEAR OF MANUFACTURE-AT EVERY 5M (BY EMBOSSING), 'BHEL-PEM' and 'CUSTOMER' Name @5m (by embossing), (ii) PROGRESSIVE SEQUENTIAL MARKING OF LENGTH OF CABLE IN METERS- AT EVERY 1M (BY EMBOSSING/PRINTING)	
12	CABLE DRUMS		
12.1	TYPE OF DRUM	WOODEN (HEAVY CONSTRUCTION) AS PER IS 10418	
12.2	STANDARD DRUM LENGTH	500M FOR LARGER SIZES / 1000M FOR SMALLER SIZES (±) 5% (AS SPECIFIED IN BOQ)	
12.3	PAINTING	ENTIRE SURFACE TO BE PAINTED. ALL FERROUS PARTS USED SHALL BE TREATED WITH SUITABLE RUST PREVENTIVE FINISH OR COATING TO AVOID RUSTING DURING TRANSIT OR STORAGE. WOODEN CABLE DRUMS SHALL BE TREATED BY IMMERSING IN COPPER-NITRATE SOLUTION. DRUM NUMBER SHALL BE INDICATED ON EACH DRUM.	
12.4	OUTERMOST LAYER	TO BE COVERED WITH WATERPROOF POLYETHYLENE	
12.5	CONSTRUCTION	ALL WOODEN PARTS FROM SEASONED WOOD AND FERROUS PARTS SHALL BE TREATED WITH SUITABLE RUST PREVENTIVE FINISH OR COATING. WOODEN DRUM SHALL BE TREATED BY IMMERSING IN COPPER NITRATE SOLUTION.	

	Design Calculations For LT Cable Selection & Sizing	
	1 x 660MW BHUSAWAL T.P.S UNIT-6	

12.6	PARTICULAR INFORMATION ON DRUM	BOTH THE END OF CABLES SHALL BE PROPERLY SEALED WITH HEAT SHRINKABLE SEAL. THE CABLE DRUMS SHALL CARRY THE FOLLOWING DETAILS IN PRINTED FORM: A) MSPGCL B) MANUFACTURER'S NAME OR TRADE MAKE C) TYPE OF CABLE & VOLTAGE GRADE D) YEAR OF MANUFACTURE E) TYPE OF INSULATION E.G. XLPE/HRPVC/IE2 F) NO. OF CORE AND SIZES OF CABLES G) CABLE CODE E.G. FRLS/FS H) SINGLE LENGTH OF CABLE ON DRUM I) DIRECTION OF ROTATION, BY ARROW J) APPROX GROSS MASS
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(B) SCREENED CONTROL CABLES

S.NO.	PARTICULARS	DETAILS
1	VOLTAGE GRADE	1100V
2	TYPE OF CABLES	TYPE F (INDIVIDUAL & OVERALL SCREENED) & TYPE G (OVERALL SCREENED)
3	CODES AND STANDARD	IS-1554 PART-1, IS-5831, IS-8130, IS-694, SEN-4241475, IEC-60332 (I).
3(i)	CONDUCTOR	
(a)	CROSS SECTION AREA	0.5 sq.mm
(b)	CONDUCTOR MATERIAL	STRANDED, TINNED ANNEALED HIGH CONDUCTIVITY COPPER
(c)	CONDUCTOR GRADE	ELECTROLYTIC
(d)	NO. & DIA OF STRANDS	7 X 0.3 mm
(e)	NO. OF PAIRS	0.5 sq.mm. - 2P, 4P, 8P, 12P, 24P
(f)	REFERENCE STANDARD	IS-8130
(ii)	INSULATION	
(a)	MATERIAL	EXTRUDED HR PVC TYPE-C AS PER IS-5831
(b)	THICKNESS IN mm	0.6 (NOMINAL) AS PER IS-694
(c)	VOLUME RESISTIVITY (MIN) IN ohm-cm	i. 1×10^{13} Ohm-cm at 27 deg.C / room temp. (Min). ii. 1×10^{10} Ohm-cm at 85 deg.C (Min.)
(d)	VOLTAGE RATING	1100V
(e)	REFERENCE STANDARD	IS-1554 PART-1 & IS-5831
(f)	OD OF COND. INCLUDING INSULATION	AS PER MANUFACTURER'S CALCULATIONS / STD. PRACTICE
(iii)	PAIRING & TWISTING	
(a)	MAX. LAY OF PAIRS (mm)	60
(b)	CONDUCTOR /PAIR IDENTIFICATION	AS PER ATTACHED ANNEXURE D
4	SHIELDING	
(a)	TYPE OF SHIELDING	AL-MYLAR TAPE
(b)	INDIVIDUAL PAIR SHIELDING	TO BE PROVIDED FOR TYPE-F CABLE ONLY
(c)	OVERALL SHIELDING	TO BE PROVIDED FOR BOTH TYPE-F & TYPE-G CABLES
(d)	MINIMUM THICKNESS OF INDIVIDUAL PAIR SHIELDING	28 MICRONS
(e)	MINIMUM THICKNESS OF OVERALL CABLE ASSEMBLY SHIELDING	60 MICRONS
(f)	SHIELDING COVERAGE	100% WITH AT LEAST 25% OVERLAP
5	DRAIN WIRE (To be provided separately for individual pair shield and overall shield.)	
	Material	Multi stranded Annealed tinned copper drain wire.
	Size (No. of strands/ Dia. of each strand)	0.5 sq. mm. (7/0.3 mm.)
6	FILLERS (if applicable)	
(a)	TYPE	NON -HYGROSCOPIC WITH FRLS PROPERTY (AS REQUIRED FOR MAINTAINING CABLE CIRCULARITY)
7	INNER SHEATH	
(a)	MATERIAL	EXTRUDED HR PVC TYPE ST-2 AS PER IS-5831
(b)	THICKNESS	AS PER IS-1554 PART-1
(c)	Whether FR-LSH Applicable	YES
(d)	COLOUR	BLACK
(e)	REFERENCE STANDARD	IS-1554 PART-1 & IS-5831
8	RIP CORD	NON-METALLIC RIP CORD UNDER THE INNER SHEATH
9	ARMOUR	GALVANISED STEEL ROUND WIRE / STRIP AS PER IS-3975 & IS-1554 PART-1

	Design Calculations For LT Cable Selection & Sizing	
	1 x 660MW BHUSAWAL T.P.S UNIT-6	

10	OUTER SHEATH		
(a)	MATERIAL	EXTRUDED HR PVC TYPE ST-2 AS PER IS-5831	
(b)	THICKNESS	AS PER IS-1554 PART-1	
(c)	Whether FR-LSH Applicable	YES	
(d)	COLOUR	GREY	
(e)	REFERENCE STANDARD	IS-1554 PART-1 & IS-5831	
(f)	MARKING	(i) CABLE SIZE (CROSS SECTION AREA AND NO. OF CORES, VOLTAGE GRADE, WORD 'FRLS', REF. IS, TYPE OF CABLE, TYPE OF INSULATION/ SHEATH, MANUFACTURER'S NAME AND/OR TRADE NAME, YEAR OF MANUFACTURE-AT EVERY 5M (BY EMBOSSING), 'BHEL-PEM' and 'CUSTOMER' Name @5m (by embossing), (ii) PROGRESSIVE SEQUENTIAL MARKING OF LENGTH OF CABLE IN METERS- AT EVERY 1M (BY EMBOSSING/PRINTING)	
11	TECHNICAL PARAMETERS (C & I) AT 20 DEG C	0.5 sqmm (IS & OS) Type F	0.5 sqmm (OS) Type G
(a)	MUTUAL CAPACITANCE (MAX.) AT 0.8 KHz, nF / Km	120	100
(b)	CONDUCTOR LOOP RESISTANCE (MAX.), Ohm / Km	78	78
(c)	INSULATION RESISTANCE (MIN.), M Ohm / Km	100	100
(d)	CROSS TALK ATTENUATION (MIN.) AT 0.8KHz, dB / Km	60	60
(e)	CHARACTERISTIC IMPEDANCE (MAX.) AT 1KHz, Ohm	320	340
(f)	ATTENUATION (MAX.) AT 1KHz, dB / Km	1.2	1.2
12	FR-LSH CHARACTERISTICS		
(b)	SMOKE DENSITY RATING	Max. 60% (As per ASTM D 2843): Area under coverage.	
(c)	ACID GAS EMISSION	Max. 20% by weight (As per IEC-60754-1)	
(d)	OXYGEN INDEX	Min 29 at room temperature (As per ASTM D 2863)	
(e)	TEMPERATURE INDEX	Min. 250 deg.C at oxygen index value of 21 (As per ASTM D 2863)	
13	FLAMMABILITY TEST	(1) AS PER IEC-332-1 (2) Swedish Chimney test SEN-SS-424-1475-F3	
14	TEST VOLTAGE & DURATION (High Voltage Test)		
(a)	Core to core	1.5 kV for 1 minute	
(b)	Core to shield	1 kV for 1 minute	
15	CABLE DRUM DETAILS		
(a)	Material Type	Wooden, as per IS 10418	
(b)	Standard drum length	1000 metres: upto and including 12 Pairs. 500 metres: above 12 pairs.	
(c)	Tolerance on drum length	±5%	
(d)	Painting	ENTIRE SURFACE TO BE PAINTED. ALL FERROUS PARTS USED SHALL BE TREATED WITH SUITABLE RUST PREVENTIVE FINISH OR COATING TO AVOID RUSTING DURING TRANSIT OR STORAGE. WOODEN CABLE DRUMS SHALL BE TREATED BY IMMERSING IN COPPER-NITRATE SOLUTION. DRUM NUMBER SHALL BE INDICATED ON EACH DRUM.	
(e)	Outermost layer	TO BE COVERED WITH WATERPROOF POLYETHYLENE	
(f)	Construction	ALL WOODEN PARTS FROM SEASONED WOOD AND FERROUS PARTS SHALL BE TREATED WITH SUITABLE RUST PREVENTIVE FINISH OR COATING. WOODEN DRUM SHALL BE TREATED BY IMMERSING IN COPPER NITRATE SOLUTION.	

		QUALITY PLAN		CUSTOMER : MAHAGENCO		PROJECT 1X660 MW BHUSAWAL TPP		SPECIFICATION :					
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01		NUMBER :					
		SHEET 1 OF 2		SYSTEM		ITEM AC ELECT. MOTORS BELOW 55KW (LV)		SECTION		VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS	
1	2	3	4	5	6	7	8	9	10	11	12	13	
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-	-		
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	2	-	-		
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	2	-	-		
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-		
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	2	1			NOTE -1 & NOTE-3
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-		NOTE -1 & NOTE-3
BHEL			PARTICULARS			BIDDER/VENDOR							
			NAME										
			SIGNATURE										

		QUALITY PLAN		CUSTOMER :		PROJECT 1X660 MW BHUSAWAL TPP			SPECIFICATION :			
				MAHAGENCO		TITLE			NUMBER :			
				BIDDER/ :		QUALITY PLAN			SPECIFICATION :			
		VENDOR		NUMBER PED-506-00-Q-006, REV-01			TITLE :					
SHEET 2 OF 2		SYSTEM		ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION			VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	
NOTES: 1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON 2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. 3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY. <u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY												
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER : MAHAGENCO		PROJECT : 1X660 MW BHUSAWAL TPP		SPECIFICATION : NUMBER :				
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE				
		SHEET 1 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION		VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	10	11	12	
1.0	RAW MATERIAL & BOUGHT OUT CONTROL											
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSPEC. REPORT	3	-	2	
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVANT IS/SPEC.	SUPPLIERS TC & LOG	3	-	2	
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-	2	
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVANT IS/	SUPPLIER'S TC	3	-	2	
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFR'S DRG.	MANUFR'S DRG.	LOG BOOK	3	-	2	
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOG BOOK	3	-	2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN SHEET 2 OF 9		CUSTOMER : MAHAGENCO		PROJECT : 1X660 MW BHUSAWAL TPP TITLE		SPECIFICATION : NUMBER :				
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE				
				SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION : VOLUME III				
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED FOR DIA OF 55 MM & ABOVE
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	MFG. DRG. SPEC.	RELEVANT IS	SUPPLIER'S TC	3	-	2	
		3. DIMENSIONS	MA	MEASUREMENT	100%	-DO-	MANUFR'S DRG.	LOG BOOK	3	-	2	
		4.INTERNAL FLAWS	CR	UT	-DO-	ASTM-A388	MANUFR'S SPEC. BHEL SPEC.	-DO-	3	2	1	
1.6	SPACE HEATERS, CONNECTORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	MANUFR'S DRG. SPEC.	MANUFR'S DRG. SPEC.	-DO-	3	-	2	
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	-DO-	3	-	2	
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG./ SPEC.	MANUFR'S DRG. / SPEC.	-DO-	3	-	2	
		4.PERFORMANCE/ CALIBRATION	MA	TEST	100%	-DO-	-DO-	INSP. REPORT	3	-	2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE									
												BIDDER'S/VENDORS COMPANY SEAL

		QUALITY PLAN SHEET 3 OF 9		CUSTOMER : MAHAGENCO		PROJECT : 1X660 MW BHUSAWAL TPP TITLE		SPECIFICATION : NUMBER :				
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE				
				SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION : VOLUME III				
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC. 2. OTHER CHARACTERISTICS	MA MA	VISUAL TEST	100% SAMPLE	- MANUF'S SPEC.	NO VISUAL DEFECTS MANUF'S SPEC.	INSPT. REPORT LOG BOOK AND OR SUPPLIER'S TC	3 3	- -	2 2	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND. 2.DIMENSIONS INCLUDING BURS HEIGHT 3. ACCEPTANCE TESTS	MA MA MA	VISUAL MEASUREMENT ELECT. & MECH TESTS	100% SAMPLE -DO-	- MANUFR'S DRG. . MANUF'S SPEC./ RELEVANT IS	NO VISUAL DEFECTS (FREE FROM BURS) MANUFR'S DRG. RELEVANT IS	LOG BOOK -DO- SUPPLIER'S TC	3 3 3	- - -	- 2 2	FOR MV MOTOR INSULATION/VARNISH THICKNESS SHALL BE MORE THAN THE BURS HEIGHT
1.9	CONDUCTORS	1. SURFACE FINISH 2.ELECT. PROP. & MECH. PROP	MA MA	VISUAL ELECT. & MECH.TEST	100% SAMPLES	- RELEVANT IS/ BS OR OTHER STANDARDS	FREE FROM VISUAL DEFECTS RELEVANT IS/ BS OR OTHER STANDARDS	LOG BOOK SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3* 3	- -	2* 2	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY BHEL/CUSTOMER.
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN SHEET 4 OF 9		CUSTOMER : MAHAGENCO		PROJECT 1X660 MW BHUSAWAL TPP		SPECIFICATION :				
				BIDDER/ :		TITLE		NUMBER :				
				VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION :				
SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION		VOLUME III						
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.10	BEARINGS	3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3	-	2	
		1.MAKE & TYPE	MA	VISUAL	100%	MANFR'S DRG./ APPROVED DATASHEET	MANFR'S DRG./ APPROVED DATASHEET	-DO-	3	-	2	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DATA SHEET	BHEL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	3	-	2	
		3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	2	
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-DO-	-DO-	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-	MANUF'S SPEC./ BHEL SPEC.	MANUF'S SPEC./ BHEL SPEC.	-DO-	3	-	2	
		4.HV/IR	MA	-DO-	100%	-DO-	-DO-	-DO-	3	-	2	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	MANUF'S DRG/SPECS	MANUF'S DRG./ SPECS.	-DO-	3	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER : MAHAGENCO		PROJECT : 1X660 MW BHUSAWAL TPP TITLE		SPECIFICATION : NUMBER :				
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE				
		SHEET 5 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION		VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
2.0	IN PROCESS											
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNES	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3/2	2	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	2	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVANT SPEC./ ASTM-E165	MANUF'S SPEC./ BHEL SPEC./	-DO-	2	-	1	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	MANFR'S SPEC/BHEL SPEC./ RELEVANT STAND	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-	-DO-	2	-	-	
		3.SHADE	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	-DO-	Log Book	2	-	-	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN SHEET 6 OF 9		CUSTOMER : MAHAGENCO		PROJECT 1X660 MW BHUSAWAL TPP			SPECIFICATION :			
				BIDDER/ : VENDOR		TITLE QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			NUMBER :			
				SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SPECIFICATION : TITLE			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION AGENCY			VOLUME III
									P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	2	-	-	(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2	-	-	
		3.CORE LOSS & HOTSPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2	1*	1	
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC.	MANUFR'S SPEC./BHEL SPEC.	Log Book	2	-	-	FOR MV MOTOR
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-	THREE DIPS TO BE GIVEN
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	2	-	-	
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN SHEET 7 OF 9		CUSTOMER : MAHAGENCO		PROJECT 1X660 MW BHUSAWAL TPP			SPECIFICATION :			
				BIDDER/ : VENDOR		TITLE			NUMBER :			
				SYSTEM		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
				ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION			VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	10	11	12	
2.7	COMPLETE STATOR ASSEMBLY	4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	VERIFICATION FOR MV MOTOR ONLY
2.8	BRAZING/COMPRESSION JOINT	1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	2	-	-	
2.9	COMPLETE ROTOR ASSEMBLY	1.COMPLETENESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.SOUNDNESS	CR	MALLET TEST & UT	-DO-	-DO-	-DO-	Log Book	2		1	
		3.HV	MA	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2		1	
2.10	ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	MFG SPEC./ ISO 1940	MFG. DWG.	Log Book	2		1	
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	2		1	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	-	
		2.WORKMANSHIP	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.AXIAL PLAY	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.DIMENSIONS	MA	-DO-	-DO-	MFG.DRG./ MFG SPEC.	MFG. DRG/ RELEVANT IS	Log Book	2	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2	-	-	
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2		1	
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE					BIDDER'S/VENDORS COMPANY SEAL				

		QUALITY PLAN SHEET 8 OF 9		CUSTOMER : MAHAGENCO		PROJECT : 1X660 MW BHUSAWAL TPP		SPECIFICATION : NUMBER :			
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE			
				SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION : VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY		
									P	W	V
1	2	3	4	5	6	7	8	9	10		
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC CLAUSE 8.1.2	MA	ELECT.TEST	1/TYPE/SIZE	IS-325/ BHEL SPEC./ DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET	TEST REPORT	2	1	1
		2.ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 ^s	1 ^s NOTE - 2
		3.VIBRATION & NOISE LEVEL	MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	2	1 ^s	1 ^s NOTE - 2
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2	1	-
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	RELEVANT IS	BHEL SPEC. AND DATA SHEET	TC	2	1*	1* REFER NOTE-3
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 ^s	1 ^s NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 ^s	1 ^s NOTE - 2
		8. NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1 ^s	1 ^s NOTE - 2
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	IS-3682 IS-8239 IS-8240	IS-3682 IS-8239 IS-8240	TC	2	-	1 TC FROM AN INDEPENDENT LABORATORY ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR.
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	2	1 ^s	1 SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY ^s NOTE - 2
BHEL			PARTICULARS			BIDDER/VENDOR					
			NAME								
			SIGNATURE								
			DATE						BIDDER'S/VENDORS COMPANY SEAL		



		QUALITY PLAN SHEET 9 OF 9		CUSTOMER : MAHAGENCO		PROJECT 1X660 MW BHUSAWAL TPP		SPECIFICATION : NUMBER :		
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE		
				SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P W V	REMARKS
1	2	3	4	5	6	7	8	9	10	11
NOTES: 1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED. 2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON. 3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED FOR FIRST NUMERAL OF IP-XX. SECOND NUMERAL TEST SHALL BE CARRIED OUT ON ONE MOTOR OF EACH TYPE & RATING. 4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. <u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY										
BHEL			PARTICULARS			BIDDER/VENDOR				
			NAME							
			SIGNATURE							
			DATE							
										BIDDER'S/VENDORS COMPANY SEAL

CABLE SCHEDULE FORMAT

ANNEXURE III

[illegible]

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

1. For the purpose of clarity, it may please be noted that the information given in regard to the cables to be routed through WinPath as per the system elaborated below is called "Cable List", while the term "Cable Schedule" applies to the cable list with routing information added after routing has been carried out.
2. The cable list shall be entered as an MS Excel file in the format as per enclosed template EXT_CAB_SCH_FORMAT.XLS. No blank lines, special characters, header, footer, lines, etc. shall be introduced in the file. No changes shall be made in the title line (first line) of the template.
3. The field properties shall be as under:
 - a. UNITCABLENO: A/N, up to sixteen (16) characters; each cable shall have its own unique, unduplicated cable number. In case this rule is violated, the cable cannot be taken up for routing.
 - b. FROM: A/N, up to sixty (60) characters; the "From" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - c. TO: A/N, up to sixty (60) characters; the "To" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - d. PURPOSE: A/N, up to sixty (60) characters; the purpose (i.e. power cable/ indication/ measurement, etc.) to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - e. REMARKS: A/N, up to forty (40) characters; Any information pertinent to routing to be specified here (e.g., cable number of the cable redundant to the cable number being entered). Information in excess of 40 characters will be truncated after 40 characters.
 - f. CABLESIZE: A/N, 7 characters exactly as per the codes indicated below shall be specified here. The program cannot route cables described in any other way/ format.
 - g. PATHCABLENO: Field reserved for utilization by the program. User shall not enter any information here.
4. One list shall be prepared for each system/ equipment (i.e., separate and unique cable lists shall be prepared for each system).
5. The cables shall be described as per the scheme listed below:

A	NN	A	NNN
Cable	No. of cores	Cable code	Cable size
Voltage	(e.g. 01,03,3H, 07)	(See C below)	(e.g. 035,185,2.5, 0.5)
Code (see B below)			

(A) SYSTEM VOLTAGE CODES:

(ac) A = 11KV, B = 6.6KV, C = 3.3KV, D = 415V, E = 240V, F = 110V

(dc) G = 220V, H = 110V, J = 48V, K = +24V, L = -24V

(B) CABLE VOLTAGE CODES:

A = 11KV (Power cables)

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

B = 6.6KV (Power cables)
 C = 3.3KV (Power cables)
 D = 1.1KV (LV & DC system power & control cables)
 E = 0.6KV (0.5 sq. mm. Control cables)

(C) CABLE CODES

PVC Copper

A = Armoured FRLS	B = Armoured Non-FRLS
C = unarmoured FRLS	D = Unarmoured Non-FRLS

PVC Aluminium

E = Armoured FRLS	F = Armoured Non-FRLS
G = unarmoured FRLS	H = Unarmoured Non-FRLS

XLPE Copper

J = Armoured FRLS	K = Armoured Non-FRLS
L = unarmoured FRLS	M = Unarmoured Non-FRLS

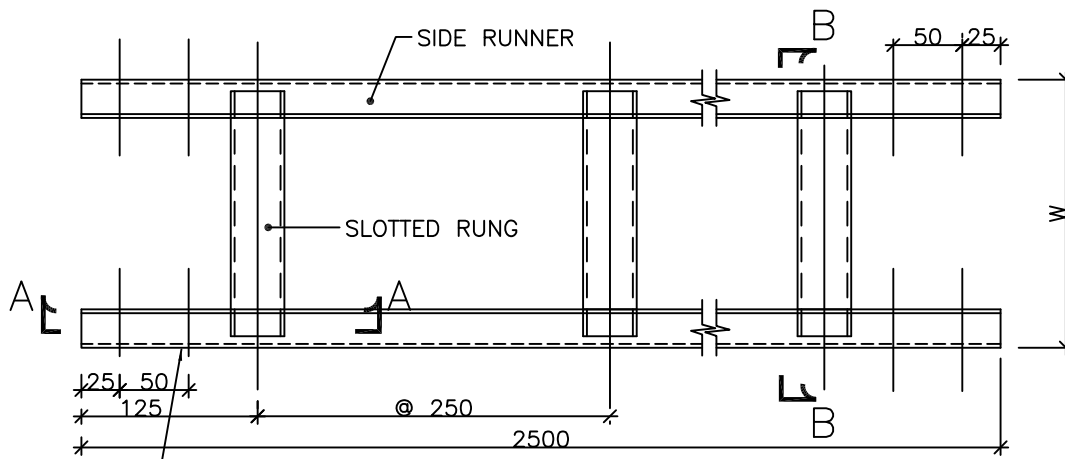
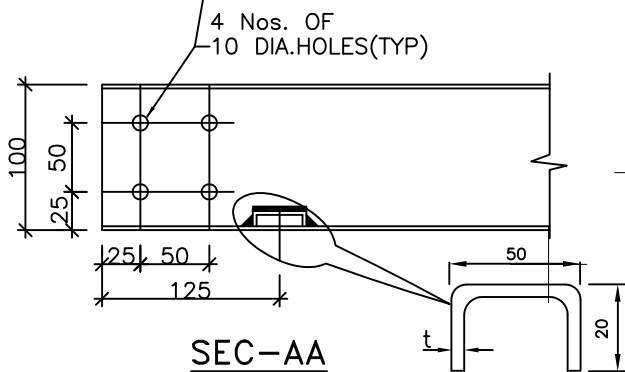
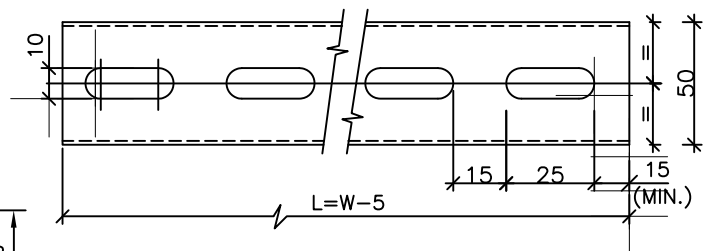
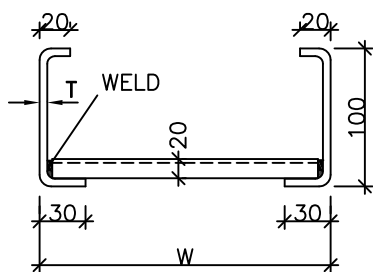
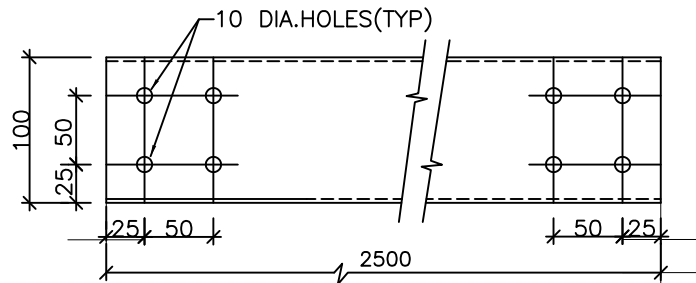
XLPE Aluminium

N = Armoured FRLS	P = Armoured Non-FRLS
Q = unarmoured FRLS	R = Unarmoured Non-FRLS

S = FIRE SURVIVAL CABLES
 T = TOUGH RUBBER SHEATH
 U = OVERALL SCREENED
 V = PAIRED OVERALL SCREENED
 W = PAIRED INDIVIDUAL SCREENED
 Y = COMPENSATING CABLES
 I = PRE-FABRICATED CABLES
 Z = JELLY FILLED CABLES

PROJECT	1 X 660 MW BHUSAWAL T.P.S. UNIT-6 TPP
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CV	ME	EL	I&C		DEPT.	SCALE NTS	BHEL DRG NO.	
					SIGN		PE-DG-415-507-E005	
					DATE		TOTAL SHEETS = 11	
						Page 156 of 30999		REV. 01

LADDER TYPE CABLE TRAYSEC-AASLOTTED RUNGSEC-BBSIDE RUNNER

W	150	300	450	600
L	145	295	445	595
T	2.0	2.0	2.0	2.0
t	2.0	2.0	2.0	2.0

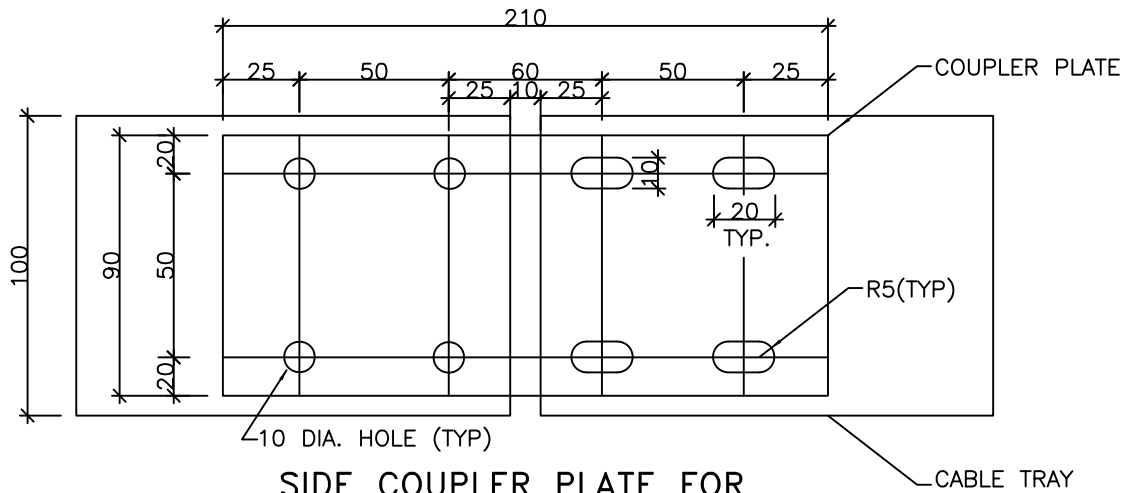
FOR GENERAL NOTES REFER SHEET 11 OF 11



TYPICAL DETAILS OF CABLE TRAYS AND
ACCESSORIES

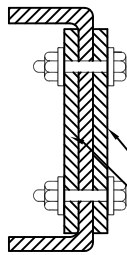
DWG. NO.
PE-DG-415-507-E005

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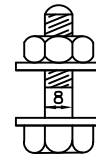


**SIDE COUPLER PLATE FOR
LADDER/PERFORATED TYPE TRAYS**
(600/450/300/150W TRAYS)

QTY. REQUIRED/TRAY SECTION : 4 NOS.

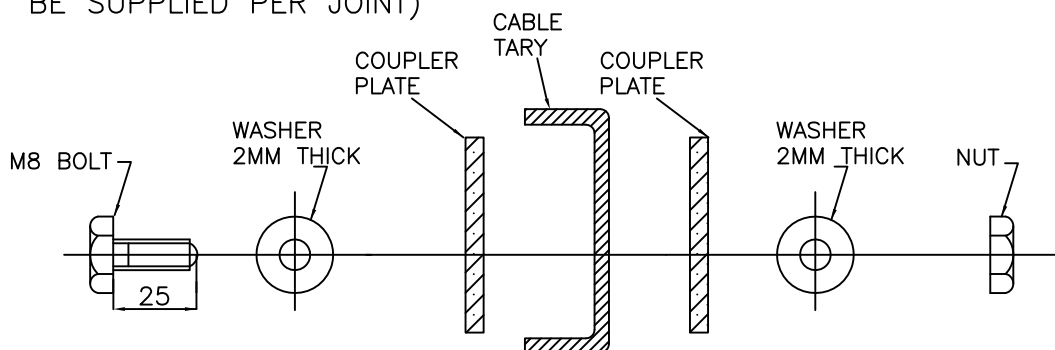


(2 NOS. COUPLER PLATES
OF 3 MM THICKNESS TO
BE SUPPLIED PER JOINT)



QTY. REQD/TRAY SECTION

- A) 16 NOS. M8 BOLTS
- B) 16 NOS. NUTS
- C) 32 NOS. WASHERS



SEQUENCE OF M8 BOLT, WASHER, NUT, COUPLER PLATE & CABLE TRAY
FOR TYPICAL CABLE TRAY JOINT

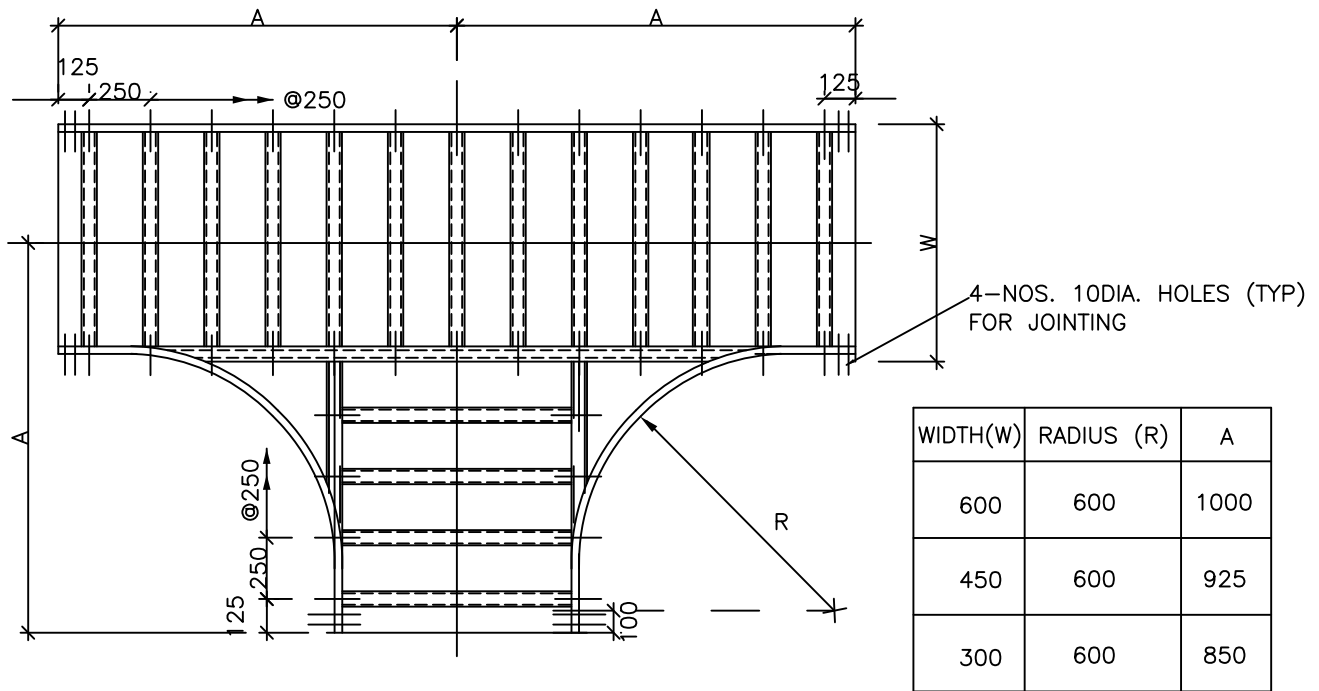
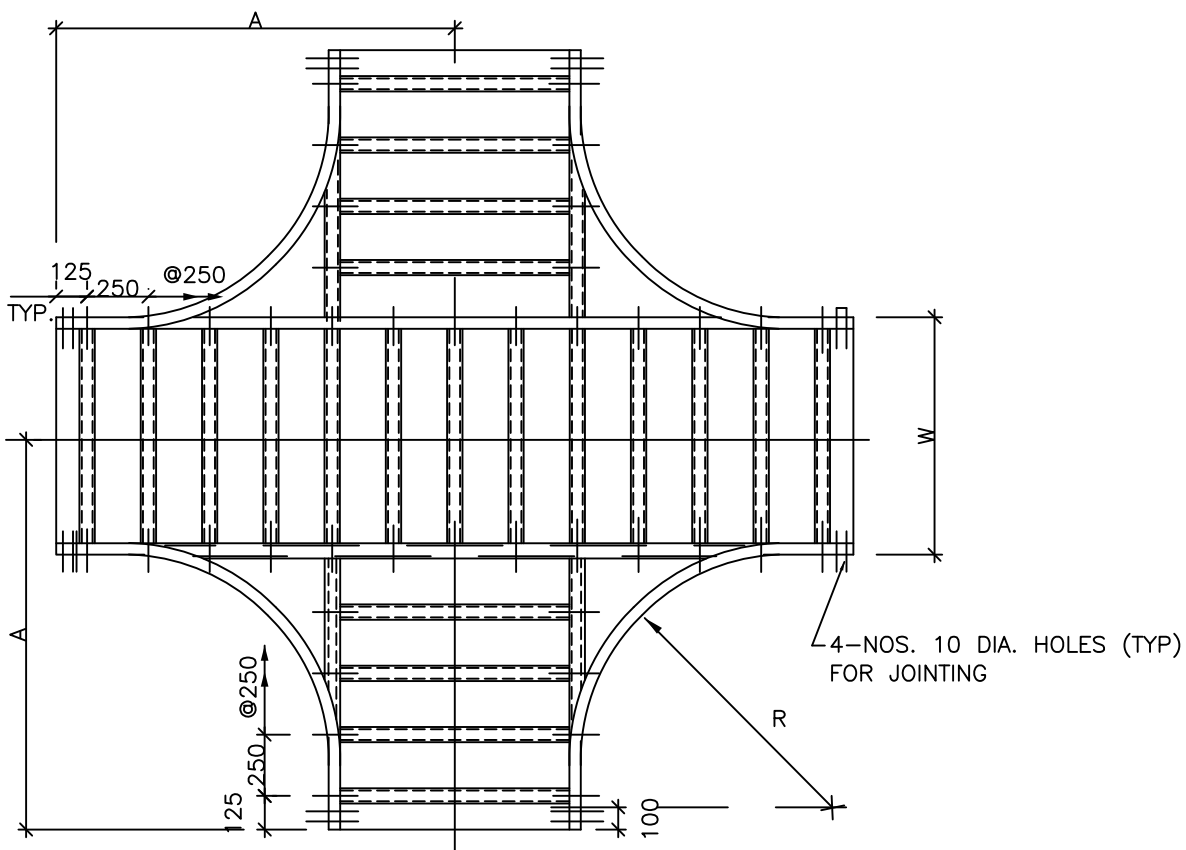
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**TYPICAL DETAILS OF CABLE TRAYS AND
ACCESSORIES**

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PE-DG-415-507-E005

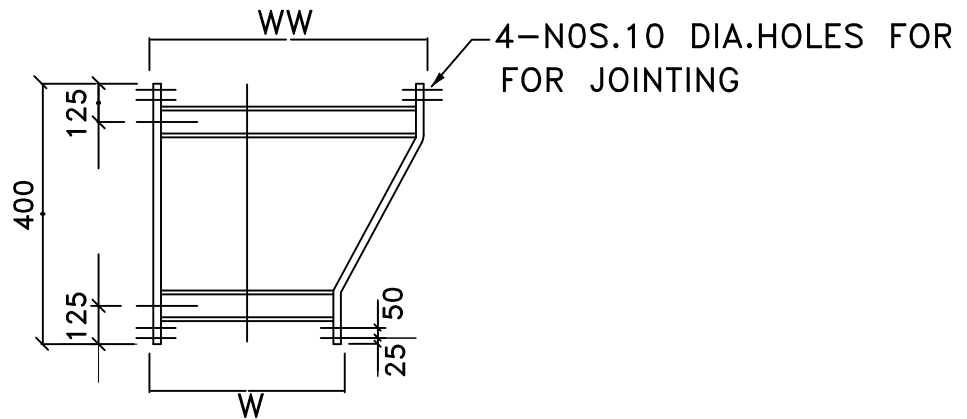
SHT. 03 OF 11 REV. 01

HORIZONTAL TEE-PLANHORIZONTAL CROSS-PLANLADDER TYPE ACCESSORIES

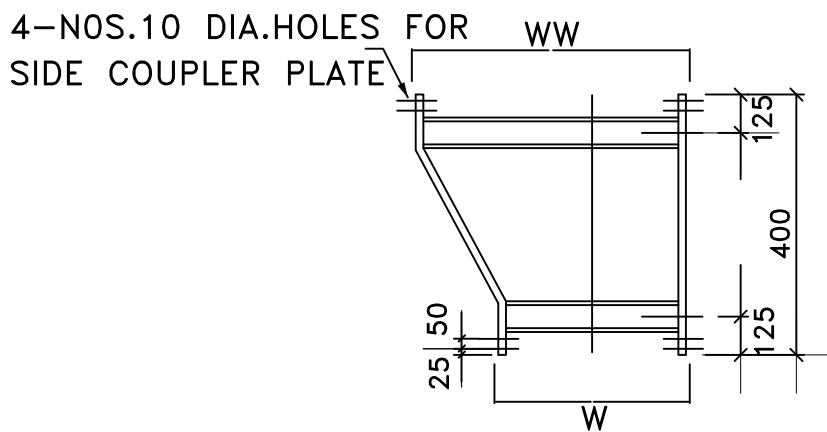
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TYPICAL DETAILS OF CABLE TRAYS AND
ACCESSORIESDWG. NO.
PE-DG-415-507-E005

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LEFT HAND REDUCER-PLAN



RIGHT HAND REDUCER-PLAN

WIDTH	WW	600	600	450
	W	450	300	300

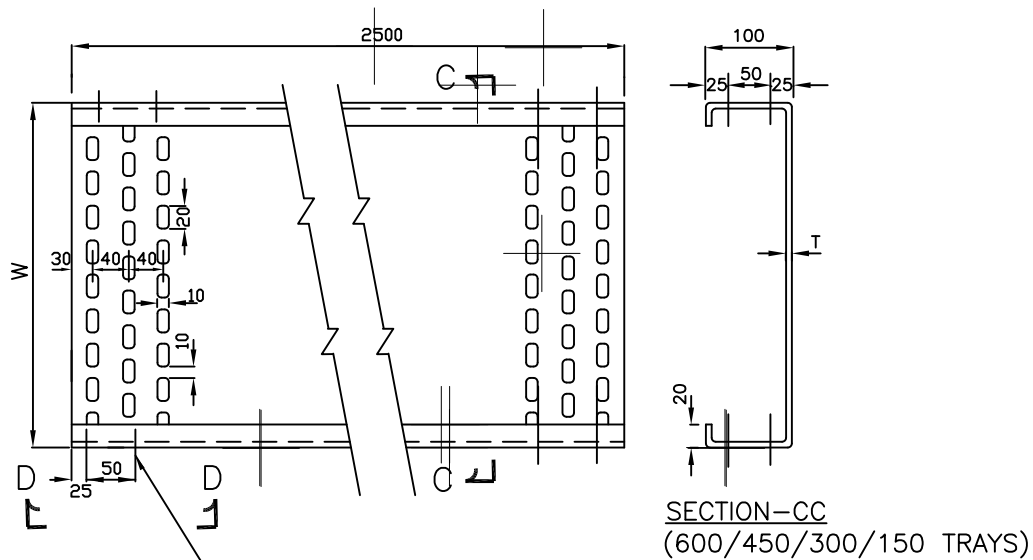
LADDER TYPE ACCESSORIES

FOR GENERAL NOTES REFER SHEET 11 OF 11

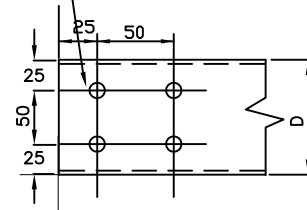


TYPICAL DETAILS OF CABLE TRAYS AND
ACCESSORIES

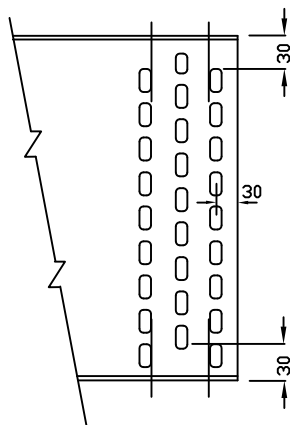
[illegible]



4 HOLES 10mm DIA.



VIEW-DD
(600/450/300/
150W TRAYS)



ARRANGEMENT OF
PERFORATIONS

TRAY WIDTH W (mm)	600	450	300	150
TRAY DEPTH D (mm)	100	100	100	100
T (mm)	2.0	2.0	2.0	2.0

PERFORATED TYPE TRAY

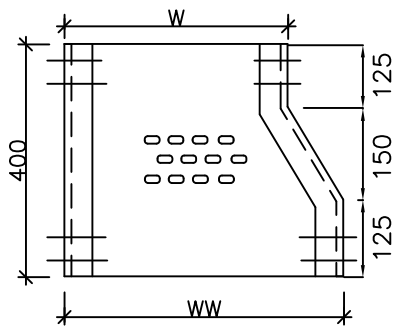
FOR GENERAL NOTES REFER SHEET 11 OF 11



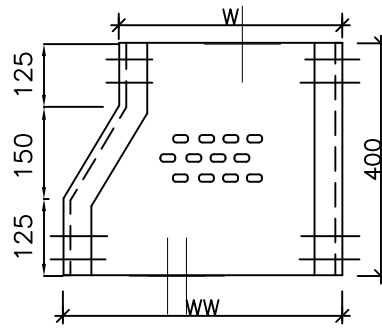
TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES

DWG. NO.
PE-DG-415-507-E005

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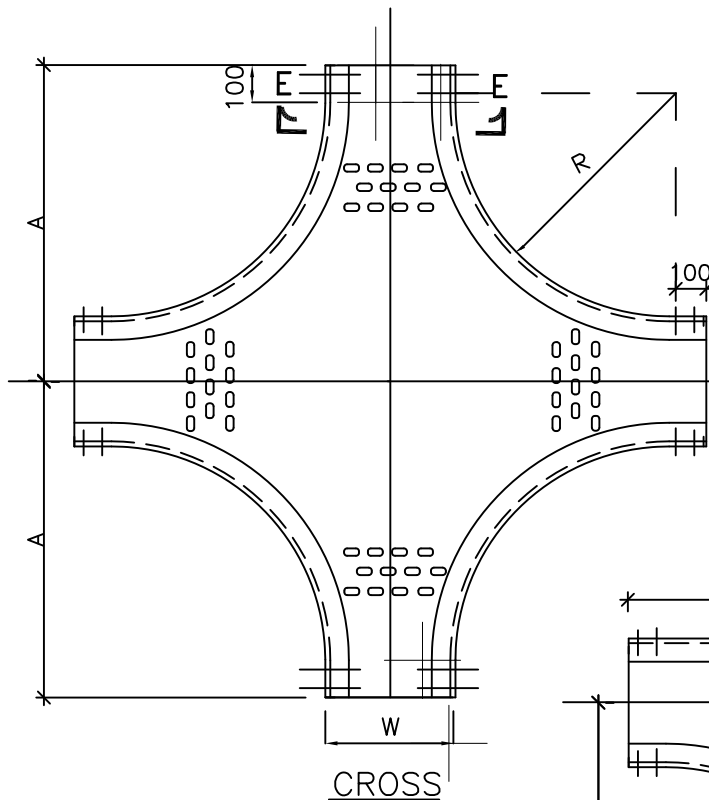
LEFT HAND REDUCER



RIGHT HAND REDUCER

WW	W	DEPTH	THICKNESS
600	450	100	2.0
600	300	100	2.0
450	300	100	2.0

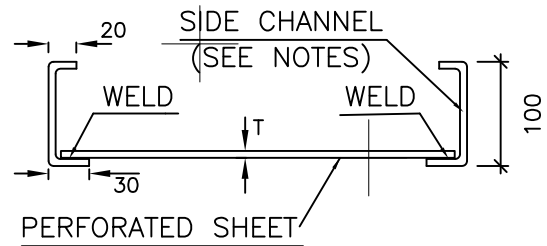
PERFORATED TYPE



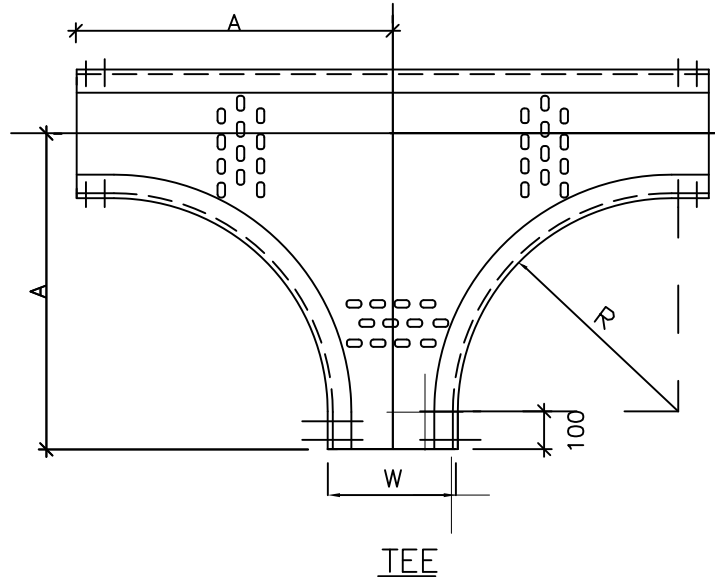
CROSS

PERFORATED TYPE

WIDTH(W)	RADIUS (R)	A	T
600	600	1000	2.0
450	600	925	2.0
300	600	850	2.0



SECTION-EE



TEE

PERFORATED TYPE ACCESSORIES

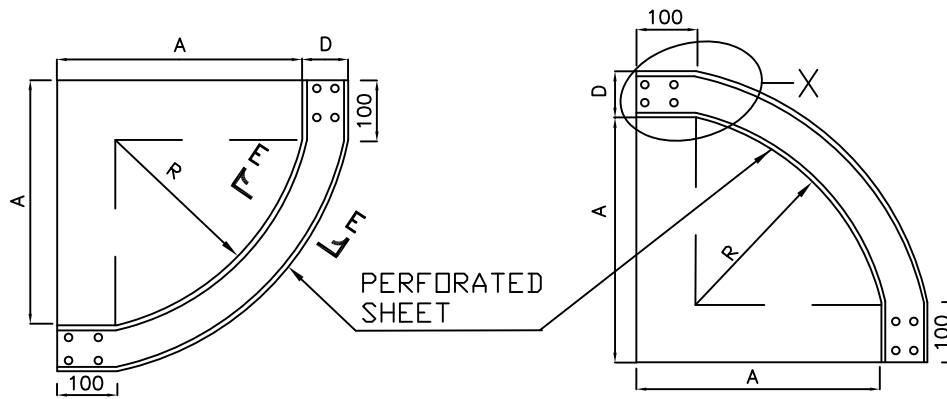
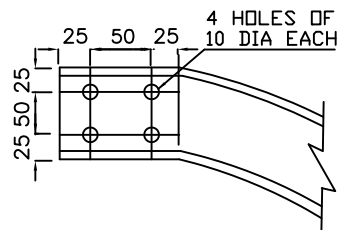
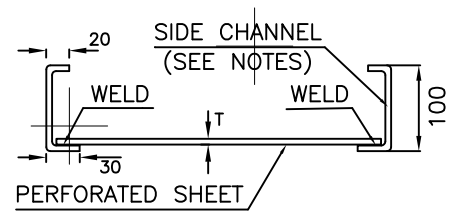
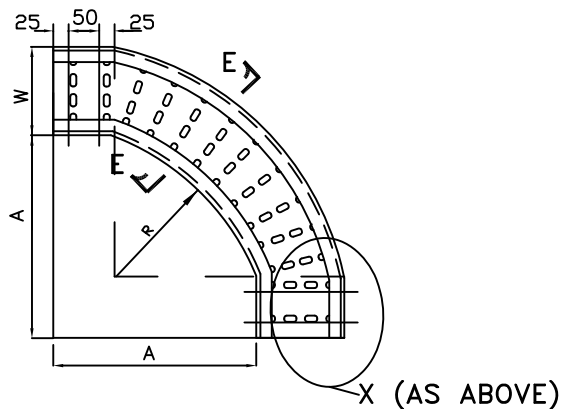
FOR GENERAL NOTES REFER SHEET 11 OF 11



TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES

DWG. NO.
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INSIDE TYPEOUTSIDE TYPEENLARGED VIEW OF "X"SECTION-EE90° VERTICAL BEND - PERFORATED TYPE90° HORIZONTAL BEND - PERFORATED TYPE

WIDTH(W)	RADIUS (R)	A	T
600	600	700	2.0
450	600	700	2.0
300	600	700	2.0

PERFORATED TYPE ACCESSORIES

FOR GENERAL NOTES REFER SHEET 11 OF 11

TYPICAL DETAILS OF CABLE TRAYS AND
ACCESSORIESDWG. NO.
PE-DG-415-507-E005

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NOTES:—

1. THE LADDER AND PERFORATED TYPE CABLE TRAYS AND ACCESSORIES (INCLUDING SIDE RUNNERS OF LADDER TYPE TRAYS & ACCESSORIES) SHALL BE MADE OF 2.0 MM HOT ROLLED M.S. SHEET. ALL THE COUPLER PLATE SHALL BE 3 MM THICK.
2. THE CABLE TRAYS & ACCESSORIES SHALL BE HOT DIP GALVANISED AS PER IS 2629. THE MASS OF ZINC COATING SHALL BE 610 gm/m² AND THICKNESS SHALL BE 86 MICRONS (MINIMUM).
3. FOR LADDER TYPE CABLE TRAYS AND ACCESSORIES, ALL RUNGS SHALL BE SLOTTED.
4. PERFORATED TRAYS SHALL BE FABRICATED OUT OF A SINGLE M.S. SHEET.
5. STANDARD TRAY ACCESSORIES SHALL BE WITH THE RADIUS INDICATED IN THIS DRAWING.
6. SIDE CHANNELS OF PERFORATED TYPE CABLE TRAY ACCESSORIES SHALL BE WELDED WITH THE PERFORATED SHEET AT INTERVALS OF 100mm.
7. LENGTH OF WELDING SHALL NOT BE LESS THAN 25mm FOR CABLE TRAYS. THE THICKNESS OF WELDING SHALL BE AS PER IS 9595.
8. ALL TRAY CORNERS SHALL BE SMOOTH AND FREE OF SHARP EDGES.
9. THE CABLE TRAY COVER SHALL BE OF 1.7 MM THICK MS SHEET AND SHALL BE HOT DIP GALVANISED.
10. THE DEPTH, WIDTH AND LENGTH OF TRAYS & TRAY COVERS SHALL BE WITHIN A TOLERANCE OF (+/-) 2 mm. THE THICKNESS TOLERANCE IS OF (+/-) 0.2 mm AS PER IS 1852.
11. THE THICKNESS OF THE FINISHED PRODUCT SHALL NOT BE LESS THAN 2.0 MM.
12. TO FACILITATE ASSEMBLY, ALL ACCESSORIES AT ENDS SHALL HAVE 100mm STRAIGHT PORTION.
13. ALL NUTS, BOLTS, WASHERS ETC., SHALL BE HOT DIP GALVANISED AS PER IS:1367 PART XIII FOR SIZES 12 MM & ABOVE, AND ELECTROPLATED/ZINC PASSIVATED FOR SIZES UPTO 12 MM.
14. ALL CUTTING & FORMING OPERATIONS SHALL BE COMPLETED PRIOR TO GALVANIZING.
15. FINISHED TRAYS SHALL BE FREE FROM BURRS AND SHARP EDGES.
16. ALL DIMENSIONS ARE IN mm UNLESS NOTED OTHERWISE.
17. WIDTH OF CABLE TRAYS PROPOSED TO BE USED FOR THE PROJECT ARE AS UNDER:
 - A) LADDER TYPE: 600W, 450W, 300W, 150W.
 - B) PERFORATED TYPE: 600W, 450W, 300W, 150W
18. THE DEPTH OF 600W, 450W, 300W, 150W TRAYS & ACCESSORIES SHALL BE 100MM.
19. DEFLECTION TEST:— A 2.5 METER STRAIGHT SECTION OF EACH TYPE OF CABLE TRAYS (150W/300W/450W/600W) SHALL BE SIMPLY SUPPORTED AT THE TWO ENDS. A UNIFORMLY DISTRIBUTED LOAD OF 100 KG/PER METER WILL BE APPLIED ALONG THE LENGTH OF THE TRAY. THE MAXIMUM DEFLECTION AT MID SPAN SHALL NOT EXCEED 7MM.



TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES

DWG. NO.
PE-DG-415-507-E005

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 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: IV-A
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 12
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VOLUME IV-A
SECTION – 12
VARIABLE FREQUENCY DRIVES

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: IV-A
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 12
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CONSULTANT : PROCON ENGINEERS

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	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 12
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1.0	CODES AND STANDARDS
2.0	TYPE
3.0	PERFORMANCE REQUIREMENT
4.0	CONTROL REQUIREMENT
5.0	PANEL CONSTRUCTION
6.0	COOLING
7.0	EQUIPMENT/COMPONENT SPECIFICATION
8.0	POWER TRANSFORMER
9.0	POWER CONVERTER
10.0	DC LINK REACTOR
11.0	OUTPUT FILTER
12.0	BY PASS FEATURE
13.0	CT/PT/METERS
14.0	LOCAL MOTOR CONTROL STATIONS
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18.0	CONTROL
19.0	INDICATORS
20.0	METERING

CONSULTANT : PROCON ENGINEERS

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1.0 <u>CODES AND STANDARDS</u> (a) DC reactor – IEC 289 (b) HT Circuit Breaker – IEC 56 (c) Motors – IS 325 / IEC 34 / IS 4722 (d) Transformers – IS 2026/IEC 60076 (e) Bushings – IS 2099 / IEC 137 (f) Bushing CT – IEC 185 / IS 2705 (g) Semiconductor converter – IEC 146 (h) AC Contactor – IEC 158-1 / VDE 0660 2.0 <u>TYPE</u> System shall be load commutated inverter type, 12-pulse design, having two channels (each channel with six pulse design) for each motor. 3.0 <u>PERFORMANCE REQUIREMENTS</u> 3.1 The system shall be energy efficient, designed as standard product and shall provide very high reliability, high power factor, low harmonic distortion and low vibration/ wear/ noise. 3.2 The system shall be designed to deliver the motor input current and torque for the complete speed torque characteristics of the ID fan, with input supply variation of $\pm 10\%$ and frequency variation of $+5\%$. It shall be capable of withstanding the thermal and dynamic stresses and the transient mechanical torque, resulting from short circuit. 3.3 The drive system shall be designed to operate in one or more of the following operating modes as to suit characteristics of the driven equipment.		

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(a) Variable torque changing as a function of speed i.e. speed squared (b) Constant torque over a specific speed range (c) Constant power over a specific speed range where the torque decreases when speed increases 3.4 The drive controller shall be equipped with microprocessor based digital regulator with programmable functions. The power control regulator logic shall provide for an acceleration/deceleration current limit curve and shall be capable of field be separately programmable from 0.1 to 20 seconds. 3.5 Each channel and motor rating shall be rated to meet fan requirements. The system shall be designed for linear continuous speed control from 20% to 100% of fan rated speed and shall be of a modern proven design and fully compatible with excitation system offered. 3.6 The Total Harmonic Distortion (THD) of the voltage and current at inverter output shall be as per IEC 61800-4 and it shall be considered in the design of the motor. 3.7 Harmonics at the supply side of the drive system at primary of the main input transformer shall be restricted within the maximum allowable levels of current and voltage distortion as per recommendations in the latest edition of IEEE-519. 3.8 The overload capacity of the controller shall be 150% of rated current of motor for one minute for constant torque applications, and 115% of rated current for one minute for variable torque application at rated voltage. If the motor load exceeds the limit, the drive shall automatically reduce the frequency and voltage to the motor to guard against overload. If the load demand exceeds the current limit for more than one (1) minute, the drive shall shut down to prevent overheating of the motor and damage to the drive. 3.9 During operation, the system shall be capable of developing sufficient torque under all load condition to respond to a 20% alteration in speed set point within a time limit up to 60 seconds.		

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3.10	The integrator action of the speed set point alteration shall be independently Adjustable for both an upward and downward alteration. The minimum time interval between set point adjustments by the distributed control system shall be considered as 10 second.	
3.11	The drive shall trip incase, the speed exceeds 105% of the maximum operational speed or reduces to 95% of the minimum operational speed for more than 10 second.	
3.12	Maximum noise level from the drive at 1meter distance, under rated load with all normal cooling fans operating shall not exceed 85dBA	
3.13	Variable frequency drive shall be arranged so that it can be operated in a circuit mode, disconnected from the motor for start up adjustment and troubleshooting/ maintenance.	
3.14	Voltage at motor neutral terminal shall be floating and neutral shall be insulated adequately for Load Commuted Inverter (LCI) operation.	
3.15	The drive system shall ensure following: (a) Harmful VFD induced harmonics which can create motor heating are eliminated. (b) VFD induced torque pulsation are limited to maximum 1% (even at low speed) so there is minimal stress to the equipment. (c) Motor is protected from dv/dt stresses. (d) No appreciable increase in motor audible noise	
3.16	Electrical performance of the system shall comply to IEEE, IEC and equivalent international standard.	
4.0	<u>CONTROL REQUIREMENT</u>	
4.1	The system shall operate on constant V/f supply with required voltage boost capability in low frequency mode of operation.	

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4.2 4.3 4.4 4.5 4.6 (a) (b) 4.7	Short time voltage dip up to 20% of nominal voltage (e.g. in case of a large motor start up connected to the same bus as VFD) shall not cause the control system to stop functioning and shall not trip the drive system. The system shall also be equipped with a facility which will restart the system in case of voltage dip over 20% or power interrupter for less than 2 seconds, with recovery of the voltage to its normal value. The drive shall have the facility to block this feature, if required by operator. Upon restart the converter shall be capable of synchronizing onto a rotating motor and develop full acceleration torque within 10 seconds. The power controller shall be controlled to always start the motor in the forward direction. Logic shall be provided to prevent the motor from being started in the reverse direction. The drive motor shall be speed controlled corresponding to 4-20mA or 0-10V reference input signal. Unless otherwise specified, upon complete loss of the users speed reference signal, the drive shall automatically run at constant speed as at 8-100% of the last speed reference available prior to the loss of signal. It shall be possible to vary the speed of the drive in either manual or auto mode. Auto/manual selection shall be from VFD panel unless otherwise specified. With the selector switch in “manual” mode, the operator shall be able to set the speed through keypad, mounted on front of the drive panel or from speed increase/decrease push buttons from the field. Motor operated potentiometer shall be provided as a speed set point device. With selector switch in “auto” mode, speed of the motor shall be controlled from a 4-20mA signal, from PLC/DCS system. Necessary equipment like protocol converter as required for interfacing with PLC/DCS shall also be provided in the drive panel The required provision for the interface with remote PLC/DCS located at control room shall be either through hardwired connection (with potential free contacts and transducers as described elsewhere in this specification).	

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4.8	Drive system shall have provision for interface with upper level automation such as substation monitoring system or electrical control system.	
4.9	The closed loop control feedback for the drive system having output transformer shall be tapped from the secondary side of the output transformer.	
5.0	<u>PANEL CONSTRUCTION</u>	
5.1	The panel shall include suitable semi conducting power devices (line-commutated thyristors/Diodes/IGBT). Modules with protective devices, reactors (if required), filters (if required), control circuit, control accessories, indication and annunciation etc, the construction of the panel shall provide effective protection against electromagnetic emissions and shall meet design requirement of integrated standards.	
5.2	Upstream breaker “ON/OFF/TRIP” indications, remote breaker closing, and trip push button shall be provided on the front door.	
5.3	Safety Interlock shall be provided so that power cabinet can't be opened unless the up stream breaker is disconnected, safety-grounding switch is closed and DC link capacitor is discharged. Power source breaker can only be closed once the earthing switch is open and panel door is closed with lock defeat facility.	
5.4	Duplicate control supply with automatic changeover shall be provided. Protection shall be provided against AC/DC transients, voltage surge etc. of power and control device.	
5.5	The drive shall be housed in sheet steel panels fabricated with 2mm thick cold rolled sheet steel. The panel shall be suitable for indoor installation, if not otherwise specified. The panel shall be free standing with degree of enclosure protection as IP-41. The maximum operating height shall be 1800mm approximately.	
5.6	Bolted un-drilled gland plate shall be provided at bottom. Clamp type terminals shall be used for connection of all wires up to 10mm ² and terminal for higher sizes shall be bolted type suitable for cable lugs.	

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Minimum space for power cable termination shall be 600mm clear from bottom of the cable gland plate. 5.7 Bus bars shall be of electrolytic copper, colour coded separately for AC and DC system. All the live parts shall be sleeved/shrouded to ensure complete safety to personnel intending to carry out routine inspection by opening the panel doors. All the equipment inside the panel and on the doors shall be provided with suitable nameplate. 5.8 All the switches, component and accessories which are essential for normal and emergency operation shall be mounted on the door and shall be operable externally. All the analog instruments, where provided, shall be switchboard type, back connected; 72x72mm. Scale shall have red mark indicating maximum permissible operating rating. 5.9 Each panel shall be provided with illuminating lamp/11W CFL with switch and fuse. 5/15A, 240V power socket with switch and fuse shall be provided. Each panel shall have space heater with switch fuse and variable setting thermostat. 5.10 Copper earth bus of min. 50x6 mm size shall be provided in the panel with provision for connection to purchaser's plant earth grid. All the non-metallic components/parts shall be connected to the main earth bus bar. Separate earth bus bar and stud for electronic control system as required shall be provided. 5.11 All the metal parts shall be treated so as to ensure efficient anti-corrosive protection. Hard wares shall be zinc passivated or electro galvanised. Panel enclosure and structure supports shall be thoroughly cleaned and degreased to remove mill scale and rust etc. External surface shall be painted Siemens grey (RAL – 7032) with two coats of synthetic enamel paint. 5.12 All panels shall be of same height so as to form a uniform line-up, to give good aesthetic appearance. 5.13 The control wiring shall be enclosed in plastic/metal channel. Each wire shall be identified at both ends by self-sticking wire marker tapes of PVC ferrules. Power and control wiring inside the panel shall be done with		

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BIS approved, PVC insulated, fire retardant, copper conductor wire. 1.5mm² size wire shall normally be used provided the control fuse rating is 10 Amps or less and 2.5mm² size for control fuse rating above 16A for electrical circuits and 0.7 mm² for electronic circuits. All wires shall be ferruled and terminals shall be properly numbered, minimum 20% spare terminal shall be provided. 5.14 All electronic modules and components shall be accessible from front of panel only. Modular assemblies for both the system control electronic equipment and power electronic equipments shall be used 5.15 All low voltage compartment and cabling shall be electrically and physically separated from the high voltage compartment. 5.16 DC link capacitor and pre charging and discharging circuit shall be preferably mounted in the rear of the panel. 5.17 Suitable removable type hooks shall be provided for lifting the panel. 5.18 Perspex type transparent insulating material shall be used for covering live compartments. 5.19 Drive keypad, operator control panel required for control, monitoring and measurements shall be supplied and installed outside the panel on the front door. It shall be accessible for operation without opening the front door and shall be non-removable type. 5.20 All the equipment shall be complete with cable glands, lugs etc. and cable glands shall be single or double compression type for indoor and outdoor equipment respectively. 6.0 <u>COOLING</u> 6.1 The drive panel shall be naturally cooled type as per manufacturer's standards. If unavoidable, forced type cooling system shall be provided. Cooling system shall include well-dimensioned panel, adequate cooling airflow path, and module cooling fan and if necessary, panel-cooling fan shall be considered. Vendor shall ensure that the panel dimensions and the flow paths have been designed for continuous running at the specified		

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ambient without overheating For fan cooled drives, redundant ventilating fans (N+1) shall be provided. 6.2 Necessary starters shall be provided within the VFD panels for the ventilation fans, any other auxiliary motor etc. The system provided shall be interfaced with drive starting and shut down such that safety interlocks such as start permit from cooling system to drive and trip signal from cooling system to drive in case of cooling system failure etc., shall be incorporated in the overall sequence logic. 6.3 MCB for motor space heater, auxiliary power supply if required for local panel, drive panel space etc. shall be included and mounted in easy accessible location. 7.0 <u>EQUIPMENT/COMPONENT SPECIFICATION</u> 7.1 <u>MOTOR</u> (a) The motor shall be suitable for operation with a solid-state power supply consisting of an adjustable frequency inverter for speed control. (b) The motor shall be suitable for the current waveforms produced by the power supply including the harmonics generated by the drive. (c) The Motor shall be designed to operate continuously at any speed over the range 20-100 % of rated speed. (d) The permitted voltage variation should take into account the steady state voltage drop across the AC drive and all other system components upstream of the motor. (e) Motors required to be transferred to DOL, by-pass mode shall be rated for specified variations in system line voltage and frequency. Starting current of motor in DOL, bypass mode shall be limited to value in motor specifications. (f) The motor shall be constructed to withstand torque pulsations resulting from harmonics generated by the solid-state power supply.		

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(g) The motor insulation shall be designed to accept the applied voltage waveform, within the V_{peak} and dv/dt limits as per IEC-61800-4. (h) The drive manufacturer shall be solely responsible for proper selection of the motor for the given load application and the output characteristics of the drive. (i) Other details shall be as given in specification of Electric motors 8.0 <u>POWER TRANSFORMER</u> Indoor dry type/Outdoor ONAN type, and shall be suitable for rating complying with system details. Other details as given in sub-section of LT Transformer specification. 9.0 <u>POWER CONVERTER</u> 9.1 The static power shall consist of a line side power converter for operation as a rectifier and a load side power converter for operation as a fully controlled inverter. Power converter shall be fast switching, most efficient and low loss type. 9.2 Adequate short circuit and over voltage protection shall be provided for the converter and inverter system. 9.3 All power converter devices shall include protective devices, snubber networks and dv/dt networks as required. 9.4 The current rating of the converter's semi-conductor components shall not be less than 120% of the nominal current flowing through the elements at full load of the VFD through the whole speed range. 9.5 All power diodes shall be of silicon type with minimum V_{bo} rating as 2.5 times the rated operating voltage. 9.6 The power converter circuit shall be designed so that motor can be powered at its full nameplate rating continuously without exceeding its		

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rated temperature rise due to harmonic currents generated by the inverter operation. 9.7 The conversion devices and associated heat sinks shall be assembled such that individual devices can be replaced without requiring the use of any special precautions/tools. 9.8 The cooling system of the electronic components, if provided, shall be monitored and necessary alarms shall be provided to prevent any consequential damage to the power control devices. 9.9 Offered system shall also take in account the distance between drive panel and motor and system shall include all material and accessories to make system suitable for a distance of 350m. 10.0 <u>DC LINK REACTOR</u> 10.1 Smoothing reactors for the DC link shall be designed to sufficiently decouple the rectifier and inverter portion of the converter and to limit fault currents in this circuit. 10.2 Reactor shall be air-core type, natural cooling and housed in a separate enclosure in ventilated room. 10.3 Reactor shall be suitable for withstanding earth fault continuously and for operation with the non-sinusoidal current wave shapes and DC components under all operational conditions of the system without exceeding its temperature limits. 10.4 Noise level shall not exceed value specified in NEMA TR-1. 11.0 <u>OUTPUT FILTER</u> 11.1 VFD output current waveform should be inherently sinusoidal at all speeds, with harmonic limits as specified in this specification. Output filter shall be provided if required. Output filter capacitors shall be provided with discharge circuits to ensure that all residual stored charge is reduced to less than 50 V DC within 300 seconds after a loss of AC voltage. All capacitor shall be maintenance free and self-healing type.		

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11.2 The VFD system shall inherently protect motor from high voltage dv/dt stress, independent of cable length to motor. Output filter shall be an integral part of the VFD system and included within the VFD enclosure. 12.0 <u>BYPASS FEATURE</u> 12.1 Bypass breaker/contactor-HRC fuse complete with protection, annunciation and metering shall be provided. 12.2 All Variable frequency drives (VFD) having bypass feature shall have motor protection relay along with necessary control and metering etc. Switching scheme shall be such that in case of drive mal-operation, the motor could be taken on bypass control manually, while the drive could be attended by opening its isolation devices. 12.3 Safety interlock between inverter and bypass breaker/contactor shall be provided such that closing of healthy device is inhibited in case of external fault. 13.0 <u>CT/PT/METERS</u> As required for the system offered and shall be suitable for variable frequency operation. 14.0 <u>LOCAL MOTOR CONTROL STATION</u> 14.1 The local motor control station is to be installed in the field near the motor. Components and accessories that are required in the local motor control station may be mounted on the local field mounted panel envisaged for the driven equipment. 14.2 Meters in the local control station shall be suitable for 4-20mA transducer outputs and shall be calibrated for the actual motor current. Further, the drives with bypass facility, the meters shall be capable of reading bypass full load and starting currents, as well as the drive current.		

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15.0 <u>PROTECTION, CONTROL, METERING, INDICATION AND ANNUNCIATION</u> 15.1 The system vendor shall provide all the necessary system control, protection; alarm equipment and metering for the entire drive system and its auxiliary equipment. 15.2 Automatic sequence control shall include start-up of cooling system, auxiliary system of the motor, interlock checking, automatic start and run-up of drive, planned and emergency shutdown. The same shall be processed through microprocessor-based system. 16.0 <u>OPERATOR CONTROL PANEL</u> 16.1 Each drive shall be equipped with a front mounted operator control panel consisting of a backlit alphanumeric display and a keypad with keys for parameterization and adjusting parameter which shall be limited to Start/Stop, Local/Remote Auto/Manual, Increase/Decrease, menu navigation and protection and measurement parameter selection, etc. also local operation during maintenance should be possible & the same shall be provided inside the panel. 16.2 All parameter names, fault messages, warnings and other information shall be displayed in complete English words or standard English abbreviations to allow the user to understand what is being displayed without the use of a manual or cross-reference table. This shall also be used for the modification of all electrical values, configuration parameters, drive menu parameters, application and activity function access, faults, local control, adjustment storage, self-test and diagnostics. Keypad shall be operable with password for changing the protection setting, safety interlock etc. However, the parameters such as measurements, setting, and mode of drive etc. shall be allowed to be viewed without any password. 16.3 Operator console shall have facility / port to connect external hardware such as Lap-Top etc. Console shall have facility for upload and download of all parameter settings from one drive to another identical drive for start up and operation.		

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16.4 16.5 17.0 17.1	Drive system control also have facility to receive tripping signal from upstream breaker for tripping and also provision for closing upstream breaker after all required process parameters are achieved. User-friendly software for operation and fault diagnostic shall be loaded in the drive system panel before commissioning. <u>PANEL PROTECTIVE FEATURES</u> The system offered shall incorporate adequate features, properly coordinated for the drive control and for motor but not limited to the following : (a) Incoming line surge protection (b) Under / Over voltage protection (c) Phase loss, phase reversal protection (d) Programmable Over current Protection and under load protection (e) Inverter fault (f) Over/under frequency (g) Ventilation loss (h) Over temperature of equipment (i) Over speed of motor (j) Specific motor protection, including motor winding, bearing temperatures, over current, Overload, negative phase sequence, locked rotor and earth fault protections etc. (k) System Earth fault protection (l) Over and under frequency, rotor earth fault, field failure protection for synchronous motor	

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(m) Additional protection for drive system 18.0 <u>CONTROL</u> 18.1 The following controls shall be provided as a part of the operators control Panel or through separate switches. (a) Start/Stop (b) Speed Control (Raise/lower) (c) Auto/Manual/Test mode (d) Local/Remote (e) Emergency Stop (f) Start/Stop for by pass starter (where specified) (g) Trip-Remote Breaker (h) Sequential switching of filters 19.0 <u>INDICATORS</u> 19.1 Vendor shall provide indications as required for normal operation and for easy maintenance, which shall be limited to the following indications : (a) Motor running (b) Motor stopped (c) VFD System Fault (d) System ready to start (e) AC mains ON		

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(f) Motor over speed (g) Rectifier output 'ON' (h) Motor zero speed (i) Rectifier breaker trip Above indications may be provided as a part of the operator control panel, i.e., door mounted keypad or through hardwired indicating lamps/LEDS. Potential free contacts of items a-d shall be wired separately for remote indications in PLC/DCS system. 20.0 <u>METERING</u> 20.1 Digital display of the following parameters shall be as a part of the Operator Control Panel, selected by the operator (a) Input AC voltage (b) Input AC frequency (c) Input AC current (d) Output voltage (e) Output current VFD / Bypass (f) Output frequency (g) Motor thermal state (h) Drive thermal state (i) Motor speed (j) Motor energy meter		

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(k) DC Link voltage (l) Hour Run Necessary transducer shall be provided with 4-20mA output for indicating motor speed and motor current in PLC/DCS unless otherwise specified for other parameters. 21.0 <u>AUDIO-VISUAL ANNUNCIATIONS</u> 21.1 The system shall incorporate audio-visual annunciations for protection, for various fault conditions, for the Drive motor, Supply cables, DC Reactor and the Converter, output transformer etc. 21.2 Alarms shall also be included for the failure of various auxiliaries together with identifications of the failing unit, loss of cooling system, various protections devices provided for converter transformer etc. 21.3 Audio-visual window annunciations shall be provided on the front of the panel. All annunciations as required for normal and satisfactorily operation of the drive system shall be included as per vendor standards. These annunciations can be part of operator console panel or separately mounted type. 21.4 Vendor shall include audio-visual alarm as required for normal operations and maintenance of the system but not limited to the following: (a) Rectifier fuse failure (b) Main AC failure (c) Inverter fuse failure (d) Inverter overload (e) Inverter high temperature (f) Cooling system failure		

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(g) Motor failed to start (h) Transformer failure (i) Battery monitoring healthiness (j) Communication and measurement system unhealthy (k) Motor temperature high (l) Harmonic filters monitoring Common potential free contacts shall be provided for above annunciations and these shall be wired up to terminal block for owner's use for remote alarm and monitoring 22.0 <u>FAULT DIAGNOSTIC</u> Fault diagnostic shall be built into the system to supervise the operation and failure of the system. The information regarding failure of any of the system including shut down of the system shall be available for a period of minimum days (96 hours) after a shut down even though no supply would be available to the system. The system may be totally de-energized for maintenance or otherwise. It shall be possible to retrieve the record of events prior to tripping of the system or de-energisation. Auxiliary supply to the system components or to the electronics (firmware) for the diagnostics/display shall be taken care by the manufacturer for this purpose. 23.0 <u>EXTERNAL POWER SUPPLY FOR AUXILIARY AND CONTROL CIRCUIT</u> Auxiliary power supply for devices external to VFD module, space heater supply for Motor, VFD panel space heater, auxiliary power supply for transformers, cubicle 11W CFL lamps etc. shall operate on 240 volts single phase AC provided by purchaser. All control circuit shall operate at maximum voltage of 240V AC		

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Vendor shall include supply of all control transformers, protective devices, required accessories etc. and any other control supply voltage as required for the system shall be derived from the power supply made available by other. 24.0 <u>RELIABILITY FEATURES</u> The expected lifetime of the drive system shall be 25 years. The system including all individual components forming part of the system shall have a minimum MTBF of 4 years. 25.0 <u>MAINTENANCE FEATURES</u> The controller design shall incorporate the following maintenance features: (a) Modular construction (b) All components shall be easily accessible. Standard diagnostics to aid maintenance personnel. These shall include LED or alphanumeric displays, test or measurement points. 26.0 <u>PAINTING</u> 26.1 All metal surfaces shall be thoroughly cleaned and de-greased to remove mill scale, rust, grease and dirt. Fabricated structures shall be pickled and then rinsed to remove any trace of acid. The under-surface shall be prepared by applying a coat of phosphate paint and a coat of yellow zinc chromate primer. The under-surface shall be made free from all imperfections before undertaking the finishing coat. 26.2 After preparation of the under surface, the panel shall be provided with epoxy based powder coating. Panel finish shall be free from imperfections like pinholes, orange peels, runoff painted. 26.3 All unpainted steel parts shall be zinc passivated, cadmium plated or suitably treated to prevent rust and corrosion. If these parts are moving elements, then these shall be greased.		

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26.4	Final paint shade shall be Siemens grey (RAL - 7032). 27.0 <u>INSPECTION, TESTING AND ACCEPTANCE</u> 27.1 During fabrication, the drive shall be subject to inspection by owner, or by an agency authorized by the owner, to assess the progress of work, as well as to ascertain that only quality raw material is used. The manufacturer shall furnish all necessary information concerning the supply to owner's inspectors. 27.2 All tests shall be carried out at the manufacturer's works under his care and expense. The tests shall be witnessed by an inspector of the owner or an agency authorized by the owner. The Contractor shall give at least four (4) weeks advance notice regarding readiness of the equipment for inspection after carrying out internal test in their works and submission of such report to OWNER/ CONSULTANT. 27.3 The routine test shall be conducted on all the drive system. However type test shall be performed on one system of each rating and type unless otherwise agreed between purchaser and manufacturer. For testing, drive system shall include input/output transformer (where applicable), switchgears, converter, filters etc. 27.4 The routine and type tests to be performed on the drive system shall be as follows : 27.4.1 Routine Tests (a) Visual Inspection It involves checking of the various equipments/components fault diagnostic unit, wiring, terminals, earthing ratings etc, in line with the approved drawings and visual inspection shall not be limited to the following: (i) Dimensions and door layout Vis-à-vis the approved drawings (ii) Degree of protection of cubicles	

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(iii) Simulation facility of control signals for testing purposes (iv) Memory function of fault diagnostic (v) Voltage/Current rating power semiconductor elements (vi) Cable termination size and number of terminals, cable-supporting etc. (vii) Accessibility of components (viii) External signals and indication/alarm signals on converter (ix) Earthing of cubicles and cubicle doors (b) Insulation Test (c) Light load and functional test (d) Load characteristics test (e) Load duty test (f) Checking of Auxiliary devices (g) Checking the properties of the control equipment (h) Checking the protective devices (i) Checking of control and functional requirements (j) High voltage test (k) Shaft current/bearing insulation (l) Automatic restart/re-acceleration		

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27.4.2 Type Tests (a) Allowable full load current versus speed (b) Efficiency (c) Temperature rise (d) EM Immunity (e) EM Emission (f) Current sharing (g) Voltage division (h) Line side current distortion content (i) Power factor (j) Audible noise (k) Torque pulsation (l) Motor vibration (m) Dynamic performance (n) Current limit and current loop test (o) Speed loop test capability to ride through voltage less than 80% (p) Test capability to restart the system and resynchronize converter onto running motor after a voltage interruption. Type test certificate from independent testing agency for similar equipment can be accepted for d, e, f, j, k and l.		

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TITLE:

TECHNICAL SPECIFICATION FOR
PRE TREATMENT PLANT (PT PLANT)
1X660 MW BHUSAWAL TPS, UNIT # 6

BHEL DOCUMENTS NO.: PE-TS-415-158A-A001

VOLUME II-R

SECTION-C 3

REV. NO. 00

DATE:

SECTION-C3
(SPECIFIC TECHNICAL REQUIRMENT-C&I)

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
CONTROL AND INSTRUMENTATION SPECIFICATION FOR PRE-TREATMENT PLANT		

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
GENERAL & SPECIFIC TECHNICAL REQUIREMENT		

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	

GENERAL REQUIREMENT

1.0 Bidder shall provide complete and independent control & instrumentation system with all accessories, auxiliaries and associated equipments for the safe, efficient and reliable operation of auxiliary systems.

2.0. The quantity of instruments for auxiliary system shall be as per tender P & ID, wherever provided, for the respective system as a minimum for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any price implication.

3.0 Measuring instruments/equipment and subsystems offered by the bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Further all the instruments shall be of proven reliability, accuracy, and acceptable international standards and shall be subject to employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specification, ranges, makes/ numbers as approved by the employer' during detail engineering.

4.0 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold and all the other accessories required for mounting/ erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments; sensors, switches etc for external connection including spare contacts shall be wired out to suitably located junction boxes.

5.0 In case of any contradiction most stringent clause/condition shall prevail.

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	

Specific Technical Requirements (C&I):

1) The control of Pre-Treatment plant shall be through DCS based control system(in BHEL scope). The operation and control philosophy of Pre-treatment plant has been elaborated in separate section in the specification. One no.Local Control Panel each for Pre-Treatment plant for DM and Pre-treatment plant for non-DM plant shall be in Bidder's scope. These local control panels (02 nos.) shall be complete with necessary lamps, push buttons, annunciation systems and mimic for local operation of the plant.

2) All electrical actuators shall be integral type.

3) The make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.

4) The solenoid valves shall have limit switches for open/close feedback.

5) Interface of MCC, HT SWGR, Actuators, solenoid drives, control valves etc. with DCS based control system shall be as per Drive Control Philosophy attached in the specification.

6) All the instruments/drives shall be terminated on JBs/Panels in field. JBs/Panels shall be in Bidder's scope. RTD's shall be of duplex type.

7) Scope of Instrumentation cables (Screened Control Cables), Fibre Optic cable & Control cables shall be as per Electrical Cable scope matrix in Electrical portion of specification. Any cable in Bidder's scope shall be as per specification.

8) Redundant 230 VAC UPS feeders shall be provided by BHEL at a single point. Further distribution to various instruments/analyzers/local panel etc. shall be in Bidder's scope. Bidder to include necessary power distribution board (ACDB) (as per details attached elsewhere in this specification) in his scope. Any power supply other than the above, if required by any instrument/device, has to be derived by the Bidder from the above supply and all necessary hardware for the same shall be in bidder's scope. Bidder to furnish UPS power requirement along with the bid.

9) Bidder to comply with codes and standards as mentioned in the specification.

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
10) All local gauges, transmitters and switches shall be mounted on suitable enclosures, racks subject to owner's approval. All transmitters shall be HART compatible. 11) Bidder to delegate /depute their persons/experts as per owner/consultants' requirement. 12) Bidder must offer general tools and tackles and special calibration instruments required during start-up, trial run, operation and maintenance of the system. 13) The above given scope is indicative & minimum. Any item/ equipment not indicated above however required for the completeness of the system is to be supplied by bidder without any technical, commercial and delivery implication to BHEL. 14) Any part/module of the C&I system which are not listed under recommended spares shall be deemed as having life expectancy not less than the expected life of the plant i.e. 30 years. 15) Instrument ranges shall be selected to have the normal reading, preferably between 50% and 70% of full scale for linear parameters and 70% to 80% for flow measurements. Deviation indicators shall have the null position at mid scale. The normal operating parameter shall be identified with a clear green mark. 16) Electronics located outside control room areas shall be tropicalized and enclosed in dust and weatherproof cabinets suitable for the environment. 17) In general, instruments installed outdoors and in areas where these may be exposed to splashing oil, water steam etc. shall be mounted in closed type enclosures. For other areas (indoor), open type racks may be used. 18) KKS identification system shall be adopted consistent with the plant equipment numbering system.		

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
C&I DELIVERABLES LIST		

LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT						
1X660 MW BHUSAWAL TPP						
DOCUMENT NUMBER PE-GL-415-145-I100						
Sl.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY	CUSTOMER	FROM	USER
INSTRUMENTATION						
1	PE-V9-415-XXX-I901	INSTRUMENT DATA SHEETS	A	-	VENDOR	C&I
2	PE-V9-415-XXX-I902	INSTRUMENT SCHEDULE	I	-	VENDOR	C&I
3	PE-V9-415-XXX-I903	INSTRUMENT INSTALLATION/ HOOK UP DIAGRAMS	A	-	VENDOR	C&I
4	PE-V9-415-XXX-I904	FIELD JB TERMINATIONS /GROUPING DOCUMENT	I	-	VENDOR	C&I
5	PE-V9-415-XXX-I905	QUALITY PLANS (CV,FE, Tx and Analyser)	A	-	VENDOR	C&I
6	PE-V9-415-XXX-I908	CONTROL SCHEMES (BLOCK LOGIC)	A	-	VENDOR	C&I
7	PE-V9-415-XXX-I909	DCS INPUT / OUTPUT SIGNAL LIST	I	-	VENDOR	C&I
8	PE-V9-415-XXX-I913	CONTROL PANEL LAYOUT/ GA DRAWING	A	-	VENDOR	C&I
9	PE-V9-415-XXX-I918	LIST OF SIGNAL EXCHANGE WITH DDCMIS (BOTH HARDWIRED & SERIAL INTERFACE IN BHEL FORMAT)	A	`	VENDOR	C&I
10	PE-V9-415-XXX-I919	PROCESS GRAPHIC MANUSCRIPTS FOR DCS	I	-	VENDOR	C&I
11	PE-V9-415-XXX-I920	PROCESS GRAPHIC MANUSCRIPTS FOR DDCMIS	I	-	VENDOR	C&I
12	PE-V9-415-XXX-I921	CABLE SCHEDULE (IN BHEL EXCEL FORMAT) & CABLE INTERCONNECTION DETAILS	I	-	VENDOR	C&I
13	PE-V9-415-XXX-I925	MANDATORY SPARES BILL OF MATERIAL	A	A	VENDOR	C&I
	Notes:	415 - Project No.				
		XXX -MAX Package Code				
		\$\$ -Approval by BHEL if Vendor BBU Item. Approval by Customer if Customer BBU Item				

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
SPECIFICATION FOR MOTORISED VALVE ACTUATOR		

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	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 11
REV: R0	ELECTRICAL EQUIPMENT & ACCESSORIES	Page 385 of 440
1.0 <u>SCOPE</u> 1.1 This Section covers the general requirements of Electric Motor Actuators for valves, dampers and gates. 1.2 All electric motor actuators shall be furnished in accordance with this general specification and the accompanying driven equipment specification. 2.0 <u>STANDARDS</u> 2.1 All electrical equipment shall conform to the latest applicable IS, ANSI and NEMA Standards, except when stated otherwise herein or in driven equipment specification. 2.2 Major standards, which shall be followed, are listed below. Other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed: (a) IS-9334 (b) IS-325 3.0 <u>SERVICE CONDITIONS</u> 3.1 The actuator shall be suitable for operation in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash. 3.2 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the general specification. 4.0 <u>RATING</u> 4.1 For isolating service, the actuator shall be rated for three successive open-close operation of the valve/damper or 15 minutes, whichever is longer. 4.2 For regulating service, the actuator shall be suitably time-rated for the duty cycle involved with necessary number of starts per hour, but in no case less than 150 starts per hour.		

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5.0 <u>PERFORMANCE</u> The actuator shall meet the following performance requirements: 5.1 Open and close the valve completely and make leak-tight valve closure without jamming. 5.2 Attain full speed operation before valve load is encountered and impart an unseating blow to start the valve in motion (hammer blow effect). 5.3 Operate the valve stem at standard stem speed and shall function against design differential pressure across the valve seat. 5.4 The motor reduction gearing shall be sufficient to lock the shaft when the motor is de-energised and prevent drift from torque switch spring pressure. 5.5 The entire mechanism shall withstand shock resulting from closing with improper setting of limit switches or from lodging of foreign matter under the valve seat. 6.0 <u>SPECIFIC REQUIREMENT</u> 6.1 <u>CONSTRUCTION</u> 6.1.1 The actuator shall essentially comprise the drive motor, torque/ limit switches, gear train, clutch, hand wheel, position indicator/ transmitter, in-built thermostat for over load protection, space heater and internal wiring. Actuator shall be integral type. Integral starter shall have facility to hook-up with Plant DCS for positioning of limit and torque switches. 6.1.2 The actuator enclosure shall be totally enclosed, dust tight, weather-proof suitable for outdoor use without necessity of any canopy. 6.1.3 All electrical equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth. 6.1.4 The actuator shall be designed for mounting in any position without any lubricant leakage or operating difficulty.		

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6.2	<u>MOTOR</u> 6.2.1 The drive motor shall be three phase, squirrel cage, induction machine with minimum class B insulation and IPW-55 enclosure, designed for high torque and reversing service. 6.2.2 The motor shall be designed for full voltage direct on-line start, with starting current limited to 6 times full-load current. 6.2.3 The motor shall be capable of starting at 85 percent of rated voltage and running at 80 percent of rated voltage at rated torque and 85 percent rated voltage at 33 percent excess rated torque for a period of 5 minutes each. 6.2.4 Earthing terminals shall be provided on either side of the motor. 6.3 <u>LIMIT SWITCHES</u> Each actuator shall be provided with following limit switches: 6.3.1 Two (2) torque limit switches, one for each direction of travel, self-locking, adjustable torque type. 6.3.2 Four (4) end-of-travel limit switches, two for each direction of travel. 6.3.3 Two (2) position limit switches, one for each direction of travel, each adjustable at any position from fully open to fully closed positions of the valve/damper. 6.3.4 Each limit switch shall have 2 NO + 2 NC potential free contacts. Contact rating shall be 5A at 240V A.C. or 0.5A at 220V D.C. 6.4 <u>HAND WHEEL</u> Each actuator shall be provided with a hand wheel for emergency manual operation. The hand wheel shall declutch automatically when the motor is energized.	

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6.5 <u>POSITION INDICATOR/TRANSMITTER</u> The actuator shall have: 6.5.1 One (1) built-in local position indicator for 0-100% travel 6.5.2 One (1) position transmitter, potentiometer type, for remote indicator. 6.6 <u>SPACE HEATER</u> A space heater shall be included in the limit switch compartment suitable for 240V, 1 phase, 50 Hz supply. 6.7 <u>WIRING</u> All electrical devices shall be wired up to and terminated in a terminal box. The internal wiring shall be of sufficient size for the power rating involved but in no case less than 1.5 Sq.mm copper. All wiring shall be identified at both ends with ferrules. 6.8 <u>TERMINAL BOX</u> The terminal box shall be weather proof, with removable front cover and cable glands for cable connection. The terminal shall be suitable for connection of 2.5 Sq.mm copper conductor. 7.0 <u>TEST</u> 7.1 The actuator and all components thereof shall be subject to tests as per relevant Standards. In addition, if any special test is called for in equipment specification, the same shall be performed. 7.2 <u>TEST WITNESS:</u> Test shall be performed in presence of Owner/Purchaser's representative so desired by the Owner/Purchaser. The Contractor shall give at least fifteen (15) days advance notice of the date when the tests are to be carried out.		

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	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
SPECIFICATION FOR FIELD INSTRUMENTS		

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	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		Section – 5
REV: R0	CONTROL & INSTRUMENTATION		Page 221 of 718
SR. NO.	ITEM	DESCRIPTION	
1.0	<u>FIELD INSTRUMENTS</u>		
	This section provides general hardware guidelines for field instruments and equipment to be supplied under this specification.		
1.1	<u>PRESSURE TRANSMITTER</u>		
1.1.1	Working Principle	SMART, HART Protocol.	
1.1.2	Type	2 – Wire.	
1.1.3	Output Signal	4-20 mA DC.	
1.1.4	Signal Processing	Silicon solid state electronic circuitry.	
1.1.5	Measuring Element	Capsule/Diaphragm.	
1.1.6	Element material	AISI-316 (Stainless Steel) or better.	
1.1.7	Static Pressure	150 % of maximum span continuously, without affecting the calibration.	
1.1.8	Turn-down ratio	100:1	
1.1.9	Span and Zero	Locally adjustable non-interacting. Facility for elevation and suppression by 100% of span.	
1.1.10	Enclosure Class	IP-65.	
1.1.11	Output Indicator	LCD Type.	
1.1.12	Nameplate	Tag number, service engraved in SS tag plate.	
1.1.13	Body	Forged Carbon Steel for air and flue gas application and SS for other	

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	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		Section – 5
REV: R0	CONTROL & INSTRUMENTATION		Page 222 of 718
SR. NO.	ITEM	DESCRIPTION	
		application.	
1.1.14	Operating Voltage	16 - 48 Volts D.C.	
1.1.15	Load	600 Ohms (min.) at 24 Volts D.C.	
1.1.16	Ambient Temperature	0 - 50 °C.	
1.1.17	Performance :		
	(a) Accuracy	± 0.1% of Span or better.	
	(b) Repeatability	± 0.05% of Span or better.	
	(c) Stability	a) +/- 0.1% of calibrated span for 5 year for ranges upto and including 70 Kg/cm ² b) +/- 0.25% of calibrated span for 5 years for ranges more than 70 kg/cm ² (g)	
1.1.18	Sealing/Isolation	Extended diaphragm with 5 meters SS armoured capillary for viscous fluid applications.	
1.1.19	Accessories	(a) Universal mounting bracket suitable for 2" pipe mounting.	
		(b) High tensile carbon steel U- bolts.	
		(c) Siphon for steam and hot water services.	
		(d) ½" NPT 2-valve stainless steel manifold, constructed from SS316 bar stock.	

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REV: R0	CONTROL & INSTRUMENTATION		Page 223 of 718
SR. NO.	ITEM	DESCRIPTION	
		(e) Companion flange with nuts, bolts and gaskets.	
		(f) Hand held configuration kit for calibration of SMART Transmitter.	
		(g) ½" NPT cable gland.	
1.2	<u>DIFFERENTIAL PRESSURE TRANSMITTER/FLOW TRANSMITTER</u>		
1.2.1	Working Principle	SMART, HART Protocol.	
1.2.2	Type	2-Wire.	
1.2.3	Output signal	4-20 mA DC.	
1.2.4	Signal Processing Unit	Silicon solid-state electronic circuitry.	
1.2.5	Measuring element	Capsule/Diaphragm.	
1.2.6	Element material	AISI-316 (Stainless Steel) or better.	
1.2.7	Static Pressure/Overload Pressure	Maximum line (or static) pressure on either side without permanent deformation or loss of accuracy.	
1.2.8	Turn-down ratio	100 : 1 minimum.	
1.2.9	Span and Zero	Locally adjustable, non-interacting.	
1.2.10	Enclosure class	IP-65.	
1.2.11	Zero suppression/elevation	At least 100% of Span.	
1.2.12	Output Indicator	LCD Type.	
1.2.13	Nameplate	Tag number and Service engraved in SS tag plate.	

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	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		Section – 5
REV: R0	CONTROL & INSTRUMENTATION		Page 224 of 718
SR. NO.	ITEM	DESCRIPTION	
1.2.14	Body	Forged Carbon Steel for air and flue gas application and SS for other application.	
1.2.15	Ambient temperature	0 - 50 °C.	
1.2.16	Operating Voltage	16 - 48 Volts DC.	
1.2.17	Load	600 Ohms (min.) at 24 Volts DC.	
1.2.18	Performance:		
	(a) Accuracy	±0.1 % of span or better.	
	(b) Repeatability	± 0.05 % of span or better.	
	(c) Stability	a) +/- 0.1% of calibrated span for 5 year for ranges upto and including 70 Kg/cm ² b) +/- 0.25% of calibrated span for 5 years for ranges more than 70 kg/cm ² (g)	
1.2.19	Sealing / Isolation	Extended diaphragm with 5 meters SS armoured capillary for viscous fluid applications.	
1.2.20	Accessories	(a) Universal mounting bracket suitable for 2" pipe mounting.	
		(b) High tensile carbon steel U-bolts.	
		(c) Siphon for steam and hot water services.	
		(d) Companion flange with nuts, bolts and gaskets.	

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume : V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		Section – 5
REV: R0	CONTROL & INSTRUMENTATION		Page 225 of 718
SR. NO.	ITEM	DESCRIPTION	
		(e) Hand held configurator kit for calibration of SMART Transmitter	
		(f) ½" NPT cable gland.	
		(g) ½" NPT generally 5-valve stainless steel manifold, constructed from SS316 bar stock. 3 valve manifold for DP application in flue gas and air.	
1.3	<u>DISPLACER TYPE LEVEL TRANSMITTERS</u>		
1.3.1	Type	SMART, HART Protocol.	
1.3.2	Stages of operation	Continuous.	
1.3.3	Material -		
(a)	Displacer	AISI 316 SS.	
(b)	Suspension wire	AISI 316 SS.	
(c)	Torque tube housing	Carbon steel or SS as per application.	
(d)	Torque tube	Inconel.	
(e)	Displacer chamber	CS or SS as per process application.	
(f)	Transmitter Housing	Die cast Aluminium or better.	
1.3.4	Operating Voltage	16-48 Volts D.C.	
1.3.5	Transmission	2-wire.	
1.3.6	Output Signal	4-20 mA DC.	
1.3.7	Signal processing	Solid-state electronic circuitry.	

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	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		Section – 5
REV: R0	CONTROL & INSTRUMENTATION		Page 226 of 718
SR. NO.	ITEM	DESCRIPTION	
1.3.8	Static / overload pressure	Maximum static pressure without permanent deformation or loss of accuracy.	
1.3.9	Turn-down ratio	10 : 1 or better.	
1.3.10	Zero & Span	Easily accessible (local zero & span adjustment and non-interactive type).	
1.3.11	Enclosure Class	IP-65.	
1.3.12	Output Indicator	LCD type.	
1.3.13	Nameplate	Tag number and Service engraved in stainless steel tag plate.	
1.3.14	Ambient Temperature	0 - 50° C.	
1.3.15	Load Impedance	600 Ohms at 24 Volts (minimum).	
1.3.16	Process Connection	2" Companion flange with nuts, bolts and gaskets.	
1.3.17	Performance -		
	(a) Accuracy	±0.5 % of span or better.	
	(b) Stability	a) +/- 0.1% of calibrated span for 5 year for ranges upto and including 70 Kg/cm ² b) +/- 0.25% of calibrated span for 5 years for ranges more than 70 kg/cm ² (g)	
1.3.18	Accessories	(a) Counter Flange, nuts, bolts, gaskets etc.	

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		(b) Weights for 5 point calibration of instruments.	
		(c) Vent and drain plugs.	
		(d) Special calibration tool / configuration, if any.	
		(e) ½"NPT cable gland.	
1.3.19	Preferred Features	(a) Test plug connection and cutout terminals physically separated from other electronics.	
		(b) Electronic Damping facility (adjustable).	
1.4	<u>MASS FLOW METER</u>		
1.4.1	Sensor		
1.4.1.1	Measuring Principle	Coriolis Mass flow.	
1.4.1.2	Primary Element	Flow Tube of 316SS or better.	
1.4.1.3	Heating Arrangement	Integral.	
1.4.1.4	Temperature Control	For heavy fuel oil application.	
1.4.1.5	Process Connection	Flanged of rating as per process requirement.	
1.4.1.6	Drain	Self-draining facility.	
1.4.1.7	Enclosure	Stainless steel.	
1.4.1.8	Accessories	Counter flanges, Mounting nuts, bolts, gaskets etc.	
1.4.2	Transmitter		

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1.4.2.1	Measured quantities	Mass Flow rate, Total Mass Flow, Density, Temperature.	
1.4.2.2	Input Signal Processing	Digital Processing.	
1.4.2.3	Display	Digital Display LCD Type.	
1.4.2.4	Output	2 off isolated 4-20mA DC output.	
1.4.2.5	Load	< 750 ohms.	
1.4.2.6	Power supply	240V AC, 50 Hz.	
1.4.2.7	Turn Down	100:1.	
1.4.2.8	Accuracy	± 0.2 % of measured value.	
1.4.2.9	Housing	IP 65.	
1.4.2.10	Nameplate	Tag number, service engraved in stainless steel tag plate.	
1.4.2.11	Accessories	(a) Handheld configurator.	
		(b) Mounting U-bolts, nuts, bolts, prefab cable etc.	
		(c) ½"NPT cable gland.	
1.5	<u>SOLID FLOW METER</u>		
1.5.1	TYPE	On-line Impact type microprocessor based.	
1.5.2	Measuring Principle	The system measurement basically pertains to the measurement of horizontal deflection using LVDT, created by the impact of Solid flow upon on-line sensing plate. The horizontal deflection being	

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1.6	<u>MASS FLOW METER (FOR AIR)</u>		
1.6.1	Sensor	Thermal dispersion	
1.6.2	Measuring Principle	The typical thermal mass sensing element contains two thermowell-protected Resistance Temperature Detectors (platinum RTDs). When placed in the process, one RTD is heated and the other RTD senses the process temperature. The temperature difference between the two RTDs is related to the process flow rate as well as the properties of the process medium.	
1.6.3	Primary Element	316 stainless steel body with Hastelloy C thermowell sensors, 316 stainless steel compression fitting with teflon or stainless steel ferrule	
1.6.4	Pressure (Maximum Operating with Damage)		
1.6.4.1	Stainless Steel Ferrule	-18°C to 121°C	
1.6.4.2	Teflon Ferrule	-18°C to 93°C	
1.6.5	Process Connection	1/2" MNPT or 3/4" MNPT with stainless steel or Teflon ferrule	
1.6.6	Transmitter		
1.6.7	Measured quantities	Mass Flow rate, Total Mass Flow	
1.6.8	Input Signal Processing	Digital Processing.	
1.6.9	Display	LCD, ±9999 counts, user scalable to flow rate	

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		engineering units or 0-100%	
1.6.10	Output	2 off isolated 4-20mA DC output	
1.6.11	Load	< 750 ohms.	
1.6.12	Power supply	240V AC, 50 Hz.	
1.6.13	Turn Down	100:1.	
1.6.14	Accuracy	± 0.2 % of measured value.	
1.6.15	Enclosure	NEMA4X (IP67) aluminum, Epoxy coated	
1.6.16	Nameplate	Tag number, service engraved in stainless steel tag plate.	
	Notes:		
1.	The above on-line flow meter shall not create any obstruction on flow.		
2.	Users' list shall be submitted to support on proven satisfactory performance for similar process applications.		
1.7	<u>PRESSURE GAUGE AND DIFFERENTIAL PRESSURE GAUGE</u>		
1.7.1	Type	Bourdon / Bellows / Diaphragm.	
1.7.2	Sensing & Socket	AISI-316 SS.	
1.7.3	Movement Material	AISI-304 SS.	
1.7.4	Case Material	Stainless steel, IP-65.	
1.7.5	Dial Size	Generally 150 mm.	
1.7.6	Scale	Black lettering on white in 270 ° arc.	

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1.7.7	Window	Shatterproof glass.	
1.7.8	Range Selection	Normal process pressure: 50~70% of range.	
1.7.9	Over-range Protection	125% of maximum range by internal stop. External stop at zero.	
1.7.10	Adjustment	Micrometer screw for zero. Internal micrometer screw for range.	
1.7.11	Element Connection	Argon welding.	
1.7.12	Process Connection	1/2" NPT(M) Bottom for local, back for panel mounting.	
1.7.13	Performance	Accuracy of ± 1.0 % of span or better.	
1.7.14	Operating ambient	0 - 50 °C.	
1.7.15	Safety Feature	Blow out disc /diaphragm at the back.	
1.7.16	Accessories	(a) Snubbers and Glycerin filled for pulsating fluid applications and at pump discharge.	
		(b) Stainless steel Diaphragm seals for viscous fluids	
		(c) 3-Way SS316 Gauge cock for pressure gauges.	
		(d) 5-valve SS316 manifold from barstock for differential pressure gauge.	
		(e) Siphons for steam and hot water services.	

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1.7.17	Applicable standard	IS-3624 / 1996.
1.7.18	Nameplate	Tag number, service engraved in stainless steel tag plate.
1.8	<u>TEMPERATURE GAUGE</u>	
1.8.1	Type	Mercury or gas filled.
1.8.2	Sensing Element Material	Bourdon - AISI-316 SS.
1.8.3	Capillary Armoring	Stainless steel flexible.
1.8.4	Movement Material	AISI 304 SS.
1.8.5	Bulb / Stem Diameter	12 mm.
1.8.6	Bulb / Stem Material	AISI 316.
1.8.7	Capillary	Stainless Steel.
1.8.8	Connection to well	½" NPT.
1.8.9	Case Material	Stainless steel.
1.8.10	Dial Size	150 mm in general.
1.8.11	Scale	Black lettering on white in 270 ° arc.
1.8.12	Mounting	Surface/Panel.
1.8.13	Over range Protection	125 % of range or more.
1.8.14	Instrument connection	Bottom for local and back for panel mounting.
1.8.15	Range	Normal temperature – 50~70% of range.
1.8.16	Zero adjuster	Micrometer screw adjustable from front.

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1.8.17	Window	Shatterproof glass.	
1.8.18	Accuracy	± 1 % or better.	
1.8.19	Enclosure Class	IP-65.	
1.8.20	Capillary	5 meters (local surface)/15.0 meters (local panel) - armoured stainless steel.	
1.8.21	Compensation	Capillary and Case Compensation.	
1.8.22	Accessories	(a) Forged barstock thermowell screwed as per ASME PTC code. Process connection M 33X2 (M). Material of construction of Thermowell: (i) SS 316: In general. (ii) Inconel: For flue gas application. (iii) Tungsten carbide: For coal mill application.	
1.8.23	Nameplate	Tag number, service engraved in stainless steel tag plate.	
1.9	<u>THERMOCOUPLES</u>		
1.9.1	Type	(a) Type-J (Iron Constantan) / Type-K (Chromel Alumel) / Type-R (Pt.-Rhodium Pt.). [As per application]	
		(b) Duplex.	
		(c) Ungrounded.	

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		thermowells.	
1.9.8	Accessories	(a) Adjustable nipple-union-nipple (½", Sch 80 x ½" NPT M) with thermowell connection.	
		(b) Compression fittings/unions.	
		(c) Flanges etc. (for flanged connections only).	
		(d) Forged barstock thermowell as per ASME PTC code. Process connection M 33 x 2 (M) in general or 1½" Flanged for Flue gas / Furnace / Air etc. application. Material of construction of Thermowell: SS 316 : In general Inconel: For flue gas application Tungsten carbide : For coal mill application.	
1.9.9	Name plate	Tag number, service engraved in stainless steel tag plate.	
1.10	<u>RESISTANCE TEMPERATURE DETECTOR</u>		
1.10.1	Type	Platinum (Duplex), Ungrounded.	
1.10.2	Resistance	100 ohm at 0 °C.	
1.10.3	Base	Wound on ceramic (anti-inductive).	
1.10.4	Wiring	3 / 4 Wire.	

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1.10.5	Protecting Tube		
(a)	O.D.	8 mm.	
(b)	Material	SS-316, Seamless.	
(c)	Filling	Magnesium oxide (Purity above 99.4%).	
1.10.6	Response time	(a) < 20 seconds for measurement.	
		(b) < 10 seconds for control.	
1.10.7	Calibration	DIN 43760.	
1.10.8	Accuracy	± 0.5%.	
1.10.9	Head:		
(a)	Type	IP-65 universal screwed type.	
(b)	Material	Die cast aluminium or better.	
(c)	Terminal blocks	Nickel plated Brass-screw type / silver plated.	
(d)	Cable connection	½" NPT gland and grommet.	
(e)	Others	Terminal head cover with SS chain and suitable gasket. All thermowells in the high velocity steam service shall be checked for Strouhal's frequency limit to arrive at a safe size and design of thermowells.	
1.10.10	Accessories	(a) Adjustable nipple-union-nipple (½" Sch 80 x ½" NPT M) with Thermowell connection.	

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		(b) Compression fittings / unions.	
		(c) Flanges etc. (for flanged connections only)	
		(d) Forged / barstock Thermowell as per ASME PTC code. Process connection M33 x 2 (M). Material of construction of Thermowell: SS 316: In general. Inconel: For flue gas application. Tungsten carbide: For coal mill application.	
1.10.11	Name plate	Tag number, service engraved in stainless steel tag plate	
1.11	<u>PRESSURE SWITCH</u>		
1.11.1	Type	(a) Piston for high pressure application.	
		(b) Bellow / Diaphragm for low pressure application.	
1.11.2	Sensing element material	AISI SS-316. All other wetted part SS316.	
1.11.3	Case Material	Die-cast aluminium alloy, neoprene gasket.	
1.11.4	Setter Scale	Black graduation on white linear scale. Graduation 0-100% with red pointer for set points.	

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1.11.5	Over range	150 % of maximum pressure.	
1.11.6	Adjustments	(a) Internal Set Point.	
		(b) Differential adjustment.	
1.11.7	End Connection	½" NPT (M) bottom connected.	
1.11.8	Switch configuration	Two SPDT.	
1.11.9	Switch Rating	240V, 5A AC / 220V, 0.5A DC.	
1.11.10	Switch Type	Snap acting, hermetically sealed, shock & vibration proof.	
1.11.11	Terminal Block	Suitable for full ring lugs.	
1.11.12	Cable connection	½" NPT conduit connection.	
1.11.13	Enclosure Class	IP-65.	
1.11.14	Performance	(a) Repeat accuracy $\pm 1.0\%$.	
		(b) Accuracy of Setting Indication of $\pm 1.5\%$.	
1.11.15	Ambient temperature	0 – 50 Deg C.	
1.11.16	Nameplate	Tag number, service engraved in SS tag plate.	
1.11.17	Accessories	(a) Remote diaphragm seal with SS-316 capillary for viscous & corrosive application.	
		(b) Siphons for steam and hot water services.	
		(c) Retention ring and screws for surface mounting.	

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		(d) 1/2" NPT 2 Valve SS-316 barstock manifold.	
		(e) ½" NPT cable gland.	
1.12	<u>DIFFERENTIAL PRESSURE SWITCH</u>		
1.12.1	Type	Bellows/Diaphragm/Piston actuated.	
1.12.2	Sensing element material	AISI SS-316. For all other wetted part SS 316.	
1.12.3	Case Material	Die-cast aluminium alloy with neoprene gasket.	
1.12.4	Setter Scale	Black graduation on white scale with 0-100% graduation and provided with red pointer for set point adjustment.	
1.12.5	Over range	Static pressure on any one side, the other side being open to atmosphere.	
1.12.6	Adjustments	(a) Internal set point adjustment.	
		(b) Differential adjustment.	
1.12.7	Process Connection	1/2" NPT (M) bottom / back connected.	
1.12.8	Switch configuration	Two SPDT.	
1.12.9	Switch rating	240V, 5A AC/220V, 0.5A DC.	
1.12.10	Switch type	Snap acting type contacts, shock and vibration proof.	
1.12.11	Terminal Blocks	Suitable for full ring lugs for cable	

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		connection.	
1.12.12	Cable Connection	½" NPT conduit connection or compression gland.	
1.12.13	Performance	(a) Repeat accuracy $\pm 1.0\%$.	
		(b) Accuracy of set point Indication: $\pm 1.5\%$	
1.12.14	Operating Ambient	0 - 50 °C (Maximum Continuous).	
1.12.15	Enclosure	IP-65.	
1.12.16	Accessories	(a) Snubbers for pulsating fluid application.	
		(b) Syphons for steam and hot water services.	
		(c) Retention ring and screws for surface mounting.	
		(d) 1/2" NPT 3-Valve SS-316 manifold constructed from barstock.	
		(e) 1/2" NPT Cable gland.	
1.12.17	Nameplate	Tag number, service engraved in stainless steel tag plate.	
1.12.18	Remote Seal type for special application	(a) Silicone oil/fluorolube filled remote diaphragm seal for dirty/viscous/corrosive fluid.	
		(b) SS armoured capillary at least 3 meters each.	

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		(c) Adapter flanges with nuts, bolts and gaskets for instrument and process side.	
1.13	<u>LEVEL SWITCH</u>		
1.13.1	Type	External cage float operated. Magnetically coupled.	
1.13.2	Float Material	AISI-316 stainless steel or better.	
1.13.3	Other wetted parts	AISI-316 stainless steel or better.	
1.13.4	External Cage	Carbon steel/Stainless steel as per process requirements, welded type/ flanged construction. Cage pressure rating shall equal or exceed the rating of the main vessel.	
1.13.5	External cage mounting	Side-Side.	
1.13.6	External cage connection	25 NB socket welded.	
1.13.7	Switch housing	Epoxy coated die-cast aluminium alloy with neoprene gasket conforming to IP-65.	
1.13.8	Type of switch configuration	2 SPDT (two nos.).	
1.13.9	Contact rating	5A, 240V/AC, 0.25A, 220V DC.	
1.13.10	Accessories	(a) Counter flange, nuts & bolts, suitable gasket etc.	
		(b) Steel globe type drain valve.	
		(c) ½"NPT cable gland.	
		(d) Stainless steel nameplate with	

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		alpha-numeric engraved for service and tag.	
1.13.11	Preferred feature	Switch operating point marked on cage.	
1.13.12	Mounting	On standpipe.	
1.14	<u>CONDUCTIVITY TYPE LEVEL SWITCH</u>		
1.14.1	Type	Conductivity discrimination.	
1.14.2	Application	Drain pots viz. on CRH line.	
1.14.3	Mounting	Flanged – on external cage.	
1.14.4	Probe MOC	Stainless steel with high purity ceramic.	
1.14.5	Probe rating	> Maximum design pressure of vessel.	
1.14.6	Input	Four independent channel with selectable switching threshold for water conductivity.	
1.14.7	Relay Output	Four isolated output relays for Hi, Lo, Hi-Hi, Lo-Lo.	
1.14.8	Contact type & rating	2 SPDT or 1 DPDT @ 5A 30V DC.	
1.14.9	Local Display	Coloured LEDs for Hi, Lo, Hi-Hi, Lo-Lo, Power & fault.	
1.14.10	Power supply	Dual 240V AC, 50 Hz, 1Ph.	
1.14.11	Enclosure	IP-65, corrosion resistant & wall mounting type (Explosion proof for NEC Class-1, Division-1 area).	

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1.14.12	Accessories	(a) PTFE cable from probe to electronics.	
		(b) Mounting accessories.	
		(c) External cage.	
		(d) Washer & gasket.	
1.14.13	Test pressure	(e) Two times rated pressure.	
1.14.14	Cable connection	(f) ½" NPT with cable gland.	
1.15	<u>CONDUCTIVITY TYPE ELECTRONIC LEVEL INDICATOR</u>		
1.15.1	Type	Conductivity discrimination.	
1.15.2	Application	HP heater level.	
1.15.3	No. of Probes	10	
1.15.4	Probe Mounting	Flanged – on standpipe.	
1.15.5	Probe MOC	Stainless steel with high purity ceramic.	
1.15.6	Probe rating	> Maximum design pressure of vessel.	
1.15.7	Input	Independent channel with selectable switching threshold for water conductivity.	
1.15.8	Relay Output	Four isolated output relays for Hi, Lo, Hi-Hi, Lo-Lo.	
1.15.9	Contact type & rating	2 SPDT or 1 DPDT @ 5A 30V DC.	

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1.16.1	Application		Low fluid velocity flow measurement.
1.16.2	Design Standard		BS-1042, Part-I.
1.16.3	Number of Tapings		As required plus one additional pair of taps.
1.16.4	Diameter Ratio		Between 0.4 to 0.7.
1.16.5	Thickness		3 mm for main pipe diameter upto 250 mm, 6 mm for main pipe diameter above 250 mm and upto 500 mm and 10 mm for main pipe diameter of 500 mm and above.
1.16.6	Document		Beta ratio calculation, assembly drawing and Flow vs. DP curve.
1.16.7	Meter run pipe		Same as pipe material.
1.16.8	Accessories		Flanges, gaskets, nuts & bolts, root valves jack screw, meter run pipe, Drain & vent hole as per application etc.
1.17	<u>FLOW NOZZLE</u>		
1.17.1	Application		High fluid velocity flow measurement.
1.17.2	Design Standard		ASME PTC 19.5.
1.17.3	Number of Tapings		As required plus one additional pair of taps.
1.17.4	Diameter Ratio		Between 0.4 and 0.7.
1.17.5	Thickness		Suitable for the application.
1.17.6	Document		Beta ratio calculation, assembly

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		drawing and Flow vs. DP curve.	
1.17.7	Meter run pipe	Same as pipe material.	
1.17.8	Accessories	Meter run pipe, nipples and root valves (Inspection port assembly for nozzles used in plant performance purpose).	
1.18	<u>GAUGE GLASS</u>		
1.18.1	Type	Reflex.	
1.18.2	Glass	Toughened borosilicate Resistant to mechanical and thermal shocks.	
1.18.3	Body material	Carbon steel / stainless steel - As per process requirements (Flanged Connection).	
1.18.4	Pressure rating	Twice the maximum working pressure.	
1.18.5	Temperature rating	As required.	
1.18.6	Bolts and nuts	Rust proof alloy steel.	
1.18.7	Accessories	Suitable ball check valves of SS-304 /316 body, gaskets, companion flange etc.	
1.19	<u>POWER CYLINDERS (PNEUMATIC)</u>		
1.19.1	Mounting Type	(a) Fixed position mounting. (End mounting)	
		(b) Trunnion mounting.	
1.19.2	Control Signal	4-20 mA DC to SMART positioner with Superimposed HART protocol for	

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		modulating purposes. 24V DC operated solenoid valve operating on pneumatic line for open & closing purpose of on & off drive.	
1.19.3	Supply Air	7 Kg / cm ² .	
1.19.4	Selection	Based upon thrust/torque, stroke length, angular movement, full-scale travel time, repeatability, space factor etc Provision for air-to-open and air-to-close operation.	
1.19.5	Casing	IP-65.	
1.19.6	Accessories	(a) Air lock relay.	
		(b) Hand wheel.	
		(c) Air filter regulator with gauge.	
		(d) Volume Booster.	
		(e) Limit Switches.	
		(f) Smart Positioner with Input and Output pressure gauges, local keypad & display.	
		(g) Solenoid Valve.	
		(h) Integral non contact type position Transmitter. (4-20 mA DC linear output)	
		(i) Junction box with cable gland.	
1.19.7	Fail-safe operation	For regulating duty- stay put against	

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		power & air fail.	
1.19.8	Repeatability	Better than 0.5% of full travel.	
1.19.9	Hysteresis	Less than $\pm 1\%$ of full travel.	
1.19.10	Operating Temp. limit	80 Deg. C (min.)	
1.20	<u>SMOKE DENSITY ANALYZER</u>		
1.20.1	Type	Insitu dry visible light. (through LED)	
1.20.2	Principle of measurement	Transmission & absorption. (Dual beam type)	
1.20.3	Light source	Modulated high intensity LED.	
1.20.4	Display	Back Lit LCD.	
1.20.5	Measurement range	0-999 mg/m ³ , 0-999 mg/Nm ³ , 0-100% Opacity.	
1.20.6	Measurement averaging	Selectable 10 sec to 60 minutes.	
1.20.7	Accuracy	0.2% opacity.	
1.20.8	Resolution	0.1% opacity.	
1.20.9	Linearity	0.1% opacity.	
1.20.10	Repeatability	0.1% opacity.	
1.20.11	Flue gas temperature	350 °C (max 600 °C).	
1.20.12	Ambient temperature	0 - 60 °C.	
1.20.13	Operating temperature	Transmitter & receiver - 0-90°C, Electronic unit - 70 °C.	

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1.25.16	Enclosure	Flame Proof.	
1.25.17	Accessories	Calibration gas, mounting accessories and others as required to be provided	
1.25.18	Application	Generator Gas Purity.	
1.26	<u>RADAR TYPE LEVEL MEASUREMENT</u>		
1.26.1	Type	Radar based on Time Domain Reflectometry.	
1.26.2	Antenna	Co axial / single rod type guided wave or Horn type as required for the application.	
1.26.3	Communication	Two wire 4-20mA DC, HART protocol.	
1.26.4	Environmental temperature	0 – 50 °C.	
1.26.5	Enclosure	Explosion proof/IP 65 as per application.	
1.26.6	Cable Entry	½" NPT.	
1.26.7	Calibration	Self calibration with internal reference.	
		Zero & Span calibration.	
1.26.8	Programming	Handheld programmer & Local keypad.	
1.26.9	Process Connection	Flanged /screwed.	
1.26.10	Electronic Housing	Epoxy painted Die-Cast aluminium alloy.	

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1.26.11	Antenna / Flange assembly	316 SS or Hest alloy. (as required)	
1.26.12	Output Indicator	Digital Integral Display.	
1.26.13	Accuracy	5 mm or 0.1% of probe length.	
1.26.14	Accessories	(a) Programming tool kit.	
		(b) Gasket.	
1.27	<u>ULTRASONIC LEVEL TRANSMITTER</u>		
1.27.1	Principle of operation	Detection of reflected ultrasonic pulse, HART Protocol	
1.27.2	Measuring ranges	Up to 30 meters (typical)	
1.27.3	Signal processing	Microprocessor Controlled Signal Processing	
1.27.4	Operating frequency	10 KHz to 50 KHz (typical)	
1.27.5	Display	Large alpha-numeric back lit LCD/ LED	
1.27.6	Calibration & Configuration	Accessible from front of panel	
1.27.7	Diagnosis	On-line	
1.27.8	Status	For power, Hi/Lo/V. Hi/V. Lo - level indication, fault etc.	
1.27.9	Construction	Plug-on board	
1.27.10	Power supply	240 V AC 50 Hz / 24V DC	
1.27.11	Signal Output	4-20 mA DC - 600 Ohm load.	

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1.27.12	Hysteresis	Fully adjustable preferred	
1.27.13	Output contacts	2 SPDT Potential free changeover contacts @ 240V, 5A AC/220V, 0.5A DC.	
1.27.14	Accuracy & Repeatability	0.25% of span or better	
1.27.15	Resolution	0.1% of span	
1.27.16	Operating Temperature	Transmitter- 50 °C and Sensor – 80 °C	
1.27.17	MOC Sensor	Body- PVC and Face – Polyurethane	
1.27.18	Humidity	1% to 95% non condensing.	
1.27.19	Enclosure	IP-65 Epoxy painted die cast aluminium or Polycarbonate housing.	
1.27.20	Cable connection	3/4" ET	
1.27.21	Mounting	2" for sensor and Transmitter on panel.	
1.27.22	Accessories	Cable gland, prefab cable, mounting accessories.	
1.28	<u>CAPACITANCE TYPE LEVEL SWITCH</u>		
1.28.1	Type	Capacitance type	
1.28.2	Probe	(i) Rod or suspended electrode	
		(ii) Rope type probes may be used only where required probe length is greater than 3 meters.	
1.28.3	Probe Mounting	Stainless steel 1½" ANSI RF Flange / ¾" NPT (M)	

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1.28.4	Material of construction	316 SS
1.28.5	Insulation	PTFE Part/ Full as per service.
1.28.6	Enclosure	Powder/Epoxy coated Die cast aluminium with neoprene gasket conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).
1.28.7	Ambient temperature	0-60 °C.
1.28.8	Mounting	On Tap
1.28.9	Supply voltage	240V AC, 50Hz /24V DC
1.28.10	Relay output	2 SPDT
1.28.11	Contact rating	240V, 5A AC/220V, 0.5A DC.
1.28.12	Response time	100 mSec or better
1.28.13	Cable connection	¾" ET
1.28.14	Accessories	Counter flange, Cable gland, prefab cable and stainless steel name plate engraved with alpha-numeric.
1.29	<u>TEMPERATURE SWITCH</u>	
1.29.1	Type	Mercury filled-in.
1.29.2	Sensing Element Material	Bellow / Bourdon AISI SS-316.
1.29.3	Bulb Material	AISI SS-316.
1.29.4	Capillary	Stainless steel armoured.
1.29.5	Movement Material	AISI SS-304.
1.29.6	Case material	Epoxy coated steel plate or die-cast aluminium alloy with neoprene gasket

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		and clear glass where applicable cover conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).	
1.29.7	Scale	Black lettering on white background.	
1.29.8	Over range Protection	120 %.	
1.29.9	Instrument connection	Bottom.	
1.29.10	Switch configuration	Two SPDT.	
1.29.11	Switch rating	240V, 5A AC/220V, 0.5A DC.	
1.29.12	Switch type	Snap acting, shock and vibration-proof.	
1.29.13	Adjustability	Internal Set point adjustable over span range.	
1.29.14	Cable connection	3/4" ET conduit connection or compression gland.	
1.29.15	Compensation	(a) Capillary compensation with invar wire throughout the capillary length.	
		(b) Case compensation.	
1.29.16	Performance :		
(a)	Scale Accuracy	±1.0 % of full scale.	
(b)	Repeatability	< 0.5 % of full range.	
(c)	Response time	Less than 40 seconds with thermowell.	
1.29.17	Capillary length	5 meters (minimum) for local mounting/15 meters for local panel mounting.	

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1.29.18	Nameplate	Tag number, service engraved in stainless steel tag plate.	
1.29.19	Accessories	Mounting accessories, 3/4"ET cable gland.	
1.30	<u>ROTAMETER</u>		
1.30.1	Type	On-line up to 2". By-pass above 2".	
1.30.2	Metering tube	Borosilicate glass.	
1.30.3	Float	AISI 316-SS unless the process fluid demands some other material.	
1.30.4	Body MOC	AISI 316-SS.	
1.30.5	Scale	Graduated- Engraved black on white background.	
1.30.6	Process connection	Flanged.	
1.30.7	Accuracy	$\pm 2\%$ of full scale detection or better for on-line type and $\pm 4\%$ of full-scale detection or better for by-pass type.	
1.30.8	Nameplate	Tag number, service engraved in stainless steel tag plate.	
1.30.9	Accessories	Slip-on orifice plate of 316-SS and taps of Stainless Steel as per application requirements. Applicable SS Isolation valves and SS Range Orifice - for bypass type rotameters.	
1.31	<u>TURBIDITY ANALYSER</u>		
1.31.1	Type	Microprocessor based continuous	

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		turbidity monitoring system	
1.31.2	Wetted parts	Stainless Steel	
1.31.3	Insulation Assembly	Yes	
1.31.4	Range	As per service application	
1.31.5	Accuracy	Better than ± 3 % of full scale	
1.31.6	Sensitivity	Measures suspended solids from 0.001 to 10,000 NTU	
1.31.7	Analyser output	4-20 mA DC – Two (2) numbers and contacts	
1.31.8	Transmitter display	Digital	
1.31.9	Type of Switch	Snap acting	
1.31.10	Switch Rating	2 NO + 2NC, SPDT, Electrically isolated 240 V AC/5A,	
1.31.11	Power supply	24V DC (for 2 wire type) & 240 V AC (for 4-wire type)	
1.31.12	Calibration	Auto & Manual (from Remote)	
1.31.13	Transmitter Housing	Die cast aluminium weather proof, dust tight & water proof conforming IP 65. For hazardous area, Explosion proof Enclosure as described in NEC article 500.	
1.32	<u>CHLORINE LEAK DETECTOR</u>		
1.32.1	Sensor Type	Electro Chemical	
1.32.2	Resolution	0.1 ppm	

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1.32.3	Response Time	Less than 1 second	
1.32.4	Display Type	7 Segment LED Display , Minimum 3 Digits with Decimal Point indications , Minimum Digit Height 12.5 mm	
1.32.5	Alarm Type	Industrial Hooter	
1.32.6	Power Supply	240 V , 50 Hz , AC, 1 Phase	
1.32.7	Output	4 to 20 mA DC	
1.32.8	Alarm Output	1NO + 1NC PF contact rated at 240V AC 5A	
1.32.9	Enclosure	Epoxy painted die cast aluminium, IP 67.	
1.32.10	Mounting	Wall Mounting with all mounting accessories	
1.33	<u>NUCLEONIC TYPE DENSITY METER</u>		
1.33.1	Type	Nucleonic type	
1.33.2	Measurement range	About 1.5 times normal density (min.)	
1.33.3	Accuracy	± 0.1% of span.	
1.33.4	Enclosure	IP 65	
1.33.5	Power supply	24 V DC / 230 V AC	
1.33.6	Output	(i) 4 –20 mA DC	
		(ii) 2 SPDT or 1 DPDT @ 5A, 30 VDC.	

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1.33.7	Local indication	Required	
1.33.8	Radioactive source	Radioactive source with regulatory approval for handling to be used.	
1.33.9	Mounting	On vessel with suitable mounting accessories.	
1.34	<u>NON-NUCLEONIC TYPE DENSITY METER</u>		
1.34.1	Type	Vibration of pendulum/ Rod	
1.34.2	Range	To suit the process.	
1.34.3	Temperature correction required	Yes/No	
1.34.4	Accuracy	± 1%	
1.34.5	Response time	Less than 1minute	
1.34.6	Sensor material	SS 316	
1.34.7	Housing material	Cast iron	
1.34.8	Enclosure protection	NEMA-4X	
1.34.9	Signal cable length	Minimum 5 meters	
1.34.10	Ambient temperature	0 Deg.C to 80 Deg.C	
1.34.11	Power supply	240 V AC + 10%, 50 Hz.	
1.34.12	Load	Minimum 600 ohms	
1.34.13	Electrical connection	¾" ET.	
1.34.14	Transmitter Output	4-20 mA DC	
1.34.15	Local Indication	LCD display Required.	

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1.34.16	Flange material	ASTM 105
1.34.17	Accessories	Suitable gaskets, Nut- bolts etc.
1.35	<u>I/P CONVERTER</u>	
1.35.1	Type	Electro-pneumatic (Outdoor Type)
1.35.2	Input level	4-20 mA DC
1.35.3	Output range	0.2 to 1.0 Kg/Sq. cm With 'Fail Freeze' feature. (i.e in case of wire snapping the last good value of pneumatic signal out put will hold for at least six hours)
1.35.4	Split range	For typical application wherever required.
1.35.5	Control Action	Selectable air to close, air to open and fail freeze application.
1.35.6	Supply pressure	1.2 to 1.6 Kg/cm ² (1.4 typical)
1.35.7	Max. supply pressure	7 Kg/ sq.cm.
1.35.8	Response Time	5 Seconds for 0 to 90% output pressure.
1.35.9	Housing	IP 55.
1.35.10	Repeatability	±0.1% of span.
1.35.11	Accuracy	± 0.25% of span.
1.35.12	Supply pressure effect	Less than 1%.
1.35.13	Span and Zero adjustments	Screw.
1.35.14	Pneumatic connection	¼" NPT.

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1.35.15	Stability	Less than 0.25% of Span / Zero for six months.	
1.35.16	Cable connection	¾” ET.	
1.35.17	Mounting	Field (pipe/wall mounting).	
1.35.18	Accessories	Air filter regulator, mounting accessories, cable gland etc.	
1.36	<u>AIR FILTER REGULATOR</u>		
1.36.1	Filter Element	Sintered Bronze.	
1.36.2	Filter Size	5 microns.	
1.36.3	Input Air	10.0 Kg/Sq. cm (maximum)	
1.36.4	Output	Adjustable from 0-2.0 Kg / Sq. cm or 0-7.0 Kg/Sq. cm (continuous) as applicable for I/P converter, control drives and control valve.	
1.36.5	Effect of Supply	Maximum 0.02 Kg/Sq. cm for a change pressure variation in supply pressure of 4 Kg/Sq. cm.	
1.36.6	Bowl Material	Metallic cover around high temperature area/clear transparent polycarbonate with metallic cover for ordinary applications.	
1.36.7	Accessories	2" dial size output pressure gauge.	
1.36.8	Desirable Feature	No perceptible drop of pressure on opening the drain port.	

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1.37	<u>SOLENOID VALVE</u>	
1.37.1	Operating Principle	Electromagnetic. (noiseless)
1.37.2	Coil voltage rating	240 V AC/220 V DC(as required. Any other voltage, if necessary, to be arranged by Bidder)
1.37.3	Ways	Generally 3-ways other depending on requirement
1.37.4	Port size	1/4" NPT all ports.
1.37.5	Body	SS bar stock.
1.37.6	Trim	SS-316.
1.37.7	Duty	Suitable for continuous energization.
1.37.8	Sealing	Airtight and leak proof.
1.37.9	Ambient Temperature	0 - 50 °C.
1.37.10	Fluid Temperature	0-150 °C (approx.)
1.37.11	Coil Enclosure	Stainless Steel.
1.37.12	Insulation	Class-H.
1.37.13	Coil Casing	IP-65 (Explosion proof for NEC Class-1, Division-1 area)
1.37.14	Mounting	On pipe or on panel.
1.37.15	Cable Connection	3/4" ET.
1.37.16	Accessories	Mounting brackets, nuts and bolts.
1.37.17	Preferred feature	(a) Solenoid valve directly integral to actuator body shall have NAMOOR interface for uniformity.

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		(b) Local indication for power.	
1.38	<u>SIGHT GLASS</u>		
1.38.1	Type	Flap-type.	
1.38.2	End connection	Screwed / Flanged.	
1.38.3	Material		
(a)	Body	CS/SS as per process medium.	
(b)	Indicator	Stainless steel.	
1.38.4	Sight Glass	Toughened Borosilicate.	
1.38.5	Gasket	Neoprene.	
1.38.6	Bolts & Nuts	High tensile steel.	
1.38.7	Hydraulic Test Pressure	1.5 times maximum working pressure.	
1.38.8	Accessories	As required.	
1.39	<u>LEVEL GAUGE (FLOAT & TAPE)</u>		
1.39.1	Type	Float and Tape	
1.39.2	Float & Tape MOC	AISI 316	
1.39.3	Pulley material	Aluminium	
1.39.4	Guide wire	SS 316 Stainless steel	
1.39.5	Accuracy	± 2 mm	
1.39.6	Indication	On circular or vertical dial	
1.39.7	Rating	Twice the design pressure	

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1.40	<u>FLOW INDICATING SWITCH</u>	
1.40.1	Type	On line metal tube Rotameter.
1.40.2	End connection	Flanged.
1.40.3	Material	
(a)	Body	CS/SS as per process medium.
(b)	Float	Stainless steel.
(c)	End fittings/flange	Stainless steel.
(d)	Other wetted part	Stainless steel.
(e)	Casing	Di cast Aluminium.
1.40.4	Accuracy	+/- 2.0% of FSR.
1.40.5	Rangeability	10:1.
1.40.6	Electrical connection	¾" ET.
1.40.7	Switch type	Snap acting hermitically sealed 2 nos. SPDT.
1.40.8	Contact rating	5A, 240V AC.
1.40.9	Protection class	IP-65.
1.40.10	Accessories	As required.
1.41	<u>ZERO SPEED SWITCH</u>	
1.41.1	Probe	
	(a) Type	Magnetic pick up (inductive type)
	(b) Size	As per requirement

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	(q) Accessories	Special cables, electronics, cabinets etc. as required to make the system complete, with bar/chain.	
	(r) Range	Application dependent.	
	(s) Range increment	0.1% of this selected range.	
	(t) Operating temperature	0 -70 °C	
	(u) Accuracy	± 0.5% FS range	
2.0	<u>CONTROL PANELS/DESK MOUNTED INSTRUMENTS AND ELECTRICAL SYSTEM ACCESSORIES</u>		
2.1	<u>COUPLING RELAY</u>		
2.1.1	Type	Octal base plug-in type/ DIN rail Mounting.	
2.1.2	Coil voltage	24 V D.C. in general / other as required.	
2.1.3	Contact	2 NO & 2 NC (Minimum).	
2.1.4	Contact rating	250 V/5A (A.C)/220V/2A (D.C).	
2.1.5	Operating range	70 to 110% of rated voltage.	
2.1.6	Insulation	2 kV for 1 minutes between terminal & earth.	
2.1.7	Mechanical life	20 million operations.	
2.1.8	Coil protection	Diode.	
2.1.9	Indication	Coil on LED.	

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2.1.10	Enclosure	Transparent cover.	
2.1.11	Connection	Screw terminals.	
2.1.12	Mounting	Projection mounting inside panel / DIN rail mounting.	
2.2	<u>DISTRIBUTION BOARDS</u>		
2.2.1	Type	Fixed, Modular.	
2.2.2	Power distribution	Through MCCB.	
2.2.3	Enclosure	Sheet Steel, IP54.	
2.2.4	Mounting	Free standing (Can be attended from both front & back).	
2.3	<u>RECEIVER RECORDER</u>		
2.3.1	Type	Microprocessor Based continuous video chart type. (Paper less)	
2.3.2	Display type	320 x 240 pixels high resolution coloured LCD graphics.	
2.3.3	Number of pen	2/4 as applicable.	
2.3.4	Input	4-20mA DC/1-5 Volt/ RTD/ Thermocouple.	
2.3.5	Display span rate	1, 5, 10, 20, 30 and 60 min / div. Selectable.	
2.3.6	Digital indication	Measured values with engineering unit.	
2.3.7	Trends	Coloured display on screen.	

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2.3.8	Colour of trends	Selectable.	
2.3.9	Performance		
(a)	Accuracy	$\pm 0.1\%$ of span or better. (Indication & Recording)	
(b)	Updation rate	1 Sec or better.	
2.3.10	Input open circuit	Up/Down Scale. (selectable)	
2.3.11	Reference Junction Compensation	Built-in cold junction compensation for thermocouple inputs.	
2.3.12	Power Supply	240 Volt, 1 Ph, 50 Hz A.C.	
2.3.13	Operating ambient temperature range	0-50 °C. (maximum)	
2.3.14	Face Dimension	144 mm (W) x 144 mm (H).	
2.3.15	Depth	300 mm (typical).	
2.3.16	Construction	Case - drawn steel, Bezel- Polycarbonate.	
2.3.17	Readable distance	3 meters (minimum)	
2.3.18	Mounting	Flush panel.	
2.3.19	Accessories	Engraved phenolic nameplate affixed to front flange to identify each recorder by tag number and each pen by color and measured variable. Shunt resistors, Ethernet port, RS232/422a/ 485 port.	
2.3.20	Features	(i) Hi, Hi-Hi, Lo and Lo-Lo contacts each channel.	

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2.3.21		(ii) 2 MB memory for Data acquisition and 100 MB Zip disk.	
		(iii) 3 ½" Floppy disk.	
		(iv) Computation functions like linear scaling, square root, differential and engineering unit and all other mathematical functions.	
		(v) Memory status display, LCD backlight saver.	
		(vi) Event sampling typically 125, 250, 500 msec.	
2.4	<u>MULTIPOINT RECORDER</u>		
2.4.1	Type	Microprocessor Based continuous video chart type. (Paper less)	
2.4.2	Number of Points	6,12 or 24. (as required)	
2.4.3	Input	4-20 mA/1-5V/Thermocouple/RTD.	
2.4.4	Recording	Channel number or dot with different color for each channel.	
2.4.5	Point Selection	Programmable for any combination of points by selection.	
2.4.6	Readable Distance	3 meters. (minimum)	
2.4.7	Data Display	Channel number, alarm status, measured data and engineering data (or Programming Display) in green LEDs.	

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2.4.8	Face Dimension	(i) 144 x 144 mm (approx.) for 6 point.	
		(ii) 252 x 206 mm (approx.) for 12 point.	
		(iii) 305 x 380 mm (approx.) for 24 point.	
2.4.9	Reference Junction Compensation	Built-in.	
2.4.10	Mounting	Flush Panel.	
2.4.11	Performance		
(a)	Accuracy	$\pm 0.5\%$ of span or better.	
(b)	Ambient Temperature effect	$\pm 0.3\%$ of span for 10 °C variation or better.	
(c)	Supply voltage variation effect	$\pm 0.2\%$ of span for 10% variation in supply voltage or better.	
(d)	Frequency variation effect	$\pm 0.1\%$ of span for 2 Hz variation in frequency or better.	
(e)	Operating Position effect	$\pm 0.1\%$ of span for 0-30 Deg. inclined or better.	
2.4.12	Input Open Circuit	Up/Down Scale.	
2.4.13	Power Supply	240 Volt, 1 Phase, 50 Hz AC.	
2.4.14	Operating Conditions :-		
(a)	Temperature	0-50 °C.	
(b)	Relative Humidity	25%-90%.	

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(c)	Supply Voltage	-15% to +10%.	
2.4.15	Accessories	Engraved phenolic nameplate affixed to front flange to identify each recorder by tag number and each pen by color and measured variable. Shunt resistors, Ethernet port, RS232/422a/485 port.	
2.4.16	Preferred Features	(i) Hi, Hi-Hi, Lo and Lo-Lo contacts for each channel.	
		(ii) 2 MB memory for Data acquisition and 100 MB Zip disk.	
		(iii) 3 ½" Floppy disk.	
		(iv) Computation functions like linear scaling, square root, differential and engineering unit and all other mathematical functions.	
		(v) Memory status display, LCD backlight saver.	
		(vi) Event sampling typically 125, 250, 500msec.	
2.5	<u>BAR GRAPH INDICATOR</u>		
2.5.1	Type	Bar graph.	
2.5.2	Number of channels	One/Two (as required)	
2.5.3	Input	4-20 mA/1-5 V/Thermocouple/RTD.	
2.5.4	Indication	Green LED / LCD.	

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2.5.5	Scale	100 mm vertical one for each channel graduated in engineering unit. (linear scale)	
2.5.6	Readable Distance	3 meters. (minimum)	
2.5.7	Mounting	Flush panel.	
2.5.8	Face Dimension	36(W) x 144(H) mm (approx) / 72 x 144 (H) mm.	
2.5.9	Resolution	1% of scale or better.	
2.5.10	Power Supply	240V, 1 Phase, 50 Hz AC.	
2.5.11	Operating Conditions :-		
(a)	Temperature	0-50 °C.	
(b)	Relative Humidity	5%-95%.	
(c)	Supply Voltage	-15% to +10%.	
2.5.12	Connection between Indicator and Tray	Prefab Cable.	
2.5.13	Accessories	(i) Mounting Tray.	
		(ii) Engraved phenolic nameplate affixed to front flange to identify each indicator by tag number and each point by measured variables.	
2.5.14	Alarm Facility	1 HI and 1 LO for each channel independently adjustable over span. Voltage free outputs.	
2.5.15	Reference Junction Compensation	Built-in cold junction compensation for	

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		thermocouple inputs.	
2.5.16	Feature	(i) Alarm level indication by flashing Cursor.	
		(ii) Green Digital display of parameter value in front panel with a 3.1/2 digit display.	
2.6	<u>VALVE POSITION INDICATOR</u>		
2.6.1	Input	4-20 mA DC/1-5 Volts DC.	
2.6.2	Indication	Pointer and Scale. Moving Coil Meter.	
2.6.3	Readable Distance	3 meters (minimum)	
2.6.4	Pointer Deflection	90 Deg Sector or linear.	
2.6.5	Mounting	Flush Panel (Horizontal/vertical)	
2.6.6	Accuracy	±1% or better.	
2.6.7	Protection Class	IP-42.	
2.6.8	Operating Ambient Temp.	0-50 °C.	
2.6.9	Scale	0-100%.	
2.6.10	Bezel Size	DIN Standard.	
2.7	<u>DIGITAL INDICATOR</u>		
2.7.1	Type	Four and half digit LED seven-segment display with sign.	
2.7.2	Face Dimension	72 x 144 mm / 48 x 96 mm. (as applicable)	
2.7.3	Display Character	13.8 mm, Green. (LED)	

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2.7.4	Accuracy	0.1% of reading, ±2 digit.	
2.7.5	Input	4-20Ma DC/1-5 V DC/ RTD/ Thermocouple.	
2.7.6	Mounting	Flush Panel.	
2.7.7	Power Supply	240V ±10%, 50 ±2.5 Hz.	
2.7.8	Output Contact	2 nos SPDT, contact rating 5A at 240V AC/ 0.25A at 220V DC.	
2.7.9	Power/Signal Connection	Screwed.	
	Large Display (150x300 mm) indicators shall be provided for MW, MVAR and frequency indications.		
2.8	<u>TOTALIZER / COUNTER</u>		
2.8.1	Type	Electronic.	
2.8.2	Number of digits and digit size	Six, 9 mm high.	
2.8.3	Input	4-20mA DC.	
2.8.4	Reset	Manual.	
2.8.5	Readable distance	3 meters. (minimum)	
2.8.6	Mounting	Flush.	
2.8.7	Performance		
(a)	Accuracy	± 0.5% of span.	
2.8.8	Operating ambient temp.	0 - 50 °C.	
2.8.9	Accessories	Engraved phenolic nameplate affixed to front flange to identify tag number and measured variable.	

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SR. NO.	ITEM	DESCRIPTION	
2.8.10	Preferred Features	Power supply on/failure LED visible from front.	
2.9	<u>PUSH BUTTON</u>		
2.9.1	Type	Shrouded square format.	
2.9.2	Face Dimension	32 x 32 mm (maximum)	
2.9.3	Contact Configuration	2 NO + 2 NC.	
2.9.4	Contact Addition	Add-on block up to 4 each with 2 pairs of contacts.	
2.9.5	Contact Material	Hard Silver Alloy.	
2.9.6	Contact Rating	500V / 10 A.	
2.9.7	Utilization Category	AC11 / DC11.	
2.9.8	Insulation Voltage	2 kV for 1 minute between terminals and earth.	
2.9.9	Mechanical Life	1 million operation.	
2.9.10	Construction	Aluminium shrouding with plastic lens.	
2.9.11	Colours	Red, Green, Yellow, Black, etc.	
2.9.12	Connection	Screw terminals.	
2.9.13	Enclosure Class	IP-52.	
2.9.14	Legend	Engraving.	
2.10	<u>ILLUMINATED PUSH BUTTON</u>		
2.10.1	Type	Square format.	
2.10.2	Face Dimension	32 x 32 mm. (maximum)	

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SR. NO.	ITEM	DESCRIPTION	
2.10.3	Contact Configuration	2 NO + 2 NC. (minimum)	
2.10.4	Contact Addition	Add-on-Block up to 4 each with 2 pairs of contacts.	
2.10.5	Contact Material	Hard Silver Alloy.	
2.10.6	Contact Rating	500 V/ 10A.	
2.10.7	Utilization Category	A C11 / DC11.	
2.10.8	Insulation Voltage	2 kV for 1 minute between terminals and earth.	
2.10.9	Mechanical Life	1 Million Operation.	
2.10.10	Lamp	LED with built-in resistors as required.	
2.10.11	Lamp Rating :		
(a)	Voltage	240 V AC.	
(b)	Watt	2 Watt (approx.)	
2.10.12	Lamp and Lens Replacement	From front.	
2.10.13	Construction	Transparent Plastic Lens.	
2.10.14	Colour	Red, Green, Amber, Yellow etc.	
2.10.15	Connection	Screw terminals.	
2.10.16	Enclosure Class	IP-52.	
2.10.17	Legend	Engraving.	
2.11	<u>SELECTOR SWITCH</u>		
2.11.1	Type	2/3/4 position stay put type with rotary lever actuator.	

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SR. NO.	ITEM	DESCRIPTION	
2.11.2	Face Dimension	32 x 32 mm. (maximum)	
2.11.3	Contact Configuration	4 pair of contacts.	
2.11.4	Contact Addition	Add-on-Block up to 4 each with 2 pairs of contact.	
2.11.5	Contact Material	Hard silver Alloy.	
2.11.6	Contact Rating	500 V/10 A.	
2.11.7	Utilization Category	AC11 / DC11.	
2.11.8	Insulation Voltage	2 kV for 1 minute between terminals and earth.	
2.11.9	Mechanical Life	1 million operation.	
2.11.10	Construction	Aluminium shrouding.	
2.11.11	Connection	Screw terminals.	
2.11.12	Enclosure Class	IP-52.	
2.12	<u>INDICATING LAMP</u>		
2.12.1	Type	LED with built-in resistor.	
2.12.2	Face Dimension	32 x 32 mm. (maximum)	
2.12.3	Voltage	240 V AC.	
2.12.4	Watt	2.5 Watt (approximate).	
2.12.5	Lamp and Lens Replacement	From front.	
2.12.6	Construction	Transparent Plastic lens.	
2.12.7	Colour	Red, Green, Amber, Yellow etc.	
2.12.8	Connection	Screw terminals.	

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SR. NO.	ITEM	DESCRIPTION	
2.12.9	Legend	Engraving.	
2.13	<u>INDICATING METERS (A.C)</u>		
2.13.1	Type	Rectifier type.	
2.13.2	Face Dimension	96 x 96 mm.	
2.13.3	Scale	Radial arc of 240 Deg.	
2.13.4	Accuracy	1.5% of full scale. ± 0.5 Hz for frequency meter.	
2.13.5	Input	0-1/0-5A for current measurement, 0-240V, 50 $\pm$ 2.5 Hz for voltage/frequency measurement.	
2.13.6	Zero Adjustment	Screw on meter face.	
2.13.7	Enclosure	Shielded Case.	
2.13.8	Mounting	Flush Panel.	
2.13.9	End Scale Suppression	6 times the measuring range only for motor ammeters.	
2.14	<u>INDICATING METERS (D.C)</u>		
2.14.1	Type	Taut band moving coil.	
2.14.2	Face Dimension	96 x 96 mm.	
2.14.3	Scale	Radial arc of 240 Deg.	
2.14.4	Accuracy	1.5% of full scale.	
2.14.5	Input	0-75 mA for current measurement. Direct reading for voltage measurement.	

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SR. NO.	ITEM	DESCRIPTION
2.14.6	Zero Adjustment	Screw on meter face.
2.14.7	Enclosure	Shielded case.
2.14.8	Mounting	Flush Panel.
2.14.9	End Scale Suppression	2 times the measuring range only for motor ammeters.
	For electrical system’s meter and for synchronization, Bidder shall refer to electrical volume of the specification.	
2.15	<u>AUXILIARY RELAY</u>	
2.15.1	Type	Electromagnetic.
2.15.2	Coil voltage	240 V A.C / 220V DC. For any other voltage bidder to make his own arrangement.
2.15.3	Contact Configuration	2 NO & 2 NC (Minimum), additional contacts as per requirement with provision for additional contact block expansion.
2.15.4	Contact rating	250V/5A. (A.C/D.C.)
2.15.5	Operating range	80 to 110% of rated voltage.
2.15.6	Insulation	2 kV for 1 minute between terminals & earth.
2.15.7	Mechanical life	20 million operations.
2.15.8	Coil protection	Diode/surge suppressor.
2.15.9	Connection	Screw terminals.
2.15.10	Mounting	Projection mounting inside panel.

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2.16	<u>ELECTRICAL TRANSDUCER</u>		
		Transducers shall be provided for conversion of AC electrical quantities such as voltage, frequency, current and power. Transducer shall be suitable for 220V DC auxiliary supply. Transducers shall be of low burden type having 4 – 20 mA DC linear galvanically isolated output compatible with secondary indicating instrument. Transducer shall be dual channel type. Accuracy class of Transducers shall be as per IS14570:1998 or IEC688 :992.	
2.17	<u>SYNCHROSCOPE</u>		
		Synchroscope shall be designed to provide an illuminate and indication of phase and frequency difference between bus voltage and Generator voltage. It shall denote the actual frequency difference corresponding to the inverse of time taken for one rotation of the illuminated vector spot. The instrument shall be designed for industrial applications, which require precise, reliable and robust instruments for the display range and indication. Synchroscope shall be designed as per the DIN/IEC/BS standards.	
2.18	<u>ANNUNCIATION</u>		
2.18.1		PLC based system alarm annunciation system shall be solid state/ microprocessor based and shall include all required logic sequence. Display part of the system shall have panel mounted facia LED array assemblies, sets of alarm accept, reset, mute and test push buttons and panel mounted audible devices.	
2.18.2		The system shall be immune to variations in the power supply and shall not generate spurious alarm when the system power is switched on (power-on-reset)	
2.18.3		Controller of the PLC/Microprocessor based control system shall be used for configuring the alarm	
2.18.4		10% wired spare channels & facia shall be provided in all cases	

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2.18.5	ANNUNCIATOR LOGIC	
	(a)	The circuit components for individual windows shall be mounted on plug -in circuit cards.
	(b)	Input shall be provided with contact bounce filtering. The filter shall delay contact inputs for 15 milliseconds to protect against input device bounce and electrical noise on input lines.
	(c)	Critical alarms shall be hardwired to the input card of annunciator controller.
2.18.6	<u>OTHER TECHNICAL PARTICULARS</u>	
	(a)	Type of contact NO or NC configurable
	(b)	Contact interrogation voltage 24 V DC
	(c)	Window drivers. Electronically short circuit protected, current limiting with automatic recovery
	(d)	Facia dimension 75 mm (W) X 50 mm (H)
	(e)	LED per facia 8 nos./Window
	(f)	Flash rate Adjustable (slow, fast, intermittent)
	(g)	Inscription Type Etched on photo film (sandwiched)
	(h)	Inscription letter height 5 mm (min.)
	(i)	No. of row of inscription/ facia 4 (max.)
	(j)	No. of letters/row 14 (max.)

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SR. NO.	ITEM	DESCRIPTION
	(k) Colour of letters	Black (for white windows)
	(l) Facia front cover	Hi-impact polystyrene
	(m) Facia rear plate	Translucent plastic
	(n) Colour of background	Milk white and red for critical / trip.
	(o) Fascia block plate	Cold rolled sheet steel epoxy painted.
	(p) Audible alarm	Cone type speaker
	(q) Tone generator	Electronic with adjustable tone, amplitude and frequency
	(r) Preferred sequence	(i) Ordinary Channel : ISA-S-18.1-1979-R
		(ii) First-up channel : ISA-S-16.1-1979- F3M3
NOTE: 1. Instruments which are open to atmosphere should be covered with proper canopy.		
3.0 <u>CONTROL VALVES, ACTUATORS & ACCESSORIES</u> General Technical Guidelines for the Control Valves shall be as follows : (a) Bidder shall exercise caution in selecting severe service control valves like BFP recirculation valves, HP & LP bypass valves, superheater & reheater attemperator valves, PRDS valves for Boiler & Turbine, Soot blower steam pressure control valve, control valves whose down stream are connected to vacuum such as HP/LP heater emergency level control, condenser make up water control valve, separator level control and CEP minimum flow control valve. For such critical applications, Bidder shall offer valves which are proven		

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4.0 <u>CONTROL DESK / PANELS / RACKS</u> (a) Convenient and logical approach to operational interfaces and aesthetics in the overall view of the panel /desk shall be considered. (b) For items susceptible to vibration, suitable anti-vibration padding shall be provided to prevent damage or malfunction. (c) All items inside the panels/cabinets shall be neatly arranged with easy access/maintenance approach. (d) Incoming power supply feeders shall be duplicated . Alarm shall be provided for failure of a power supply feed. (e) Desk/panel shall be provided with interior illumination, utility receptacles with plug and cooling fan. (f) Panel/Desk shall have gland plate at cable entry to panel. Thickness of gland plate shall not be less than 3 mm. (g) Wire shall be routed/laid through covered trough. (h) Crating of the panels and desks shall be suitable for protection against shock, vibration, inappropriate handling and inclement weather conditions during transportation and warehousing. Mounted equipment shall have adequate protection against damage during handling, transit and storage. Suitable desiccant shall be used inside the packing case. (i) Nameplate (i) Nameplate shall be provided for instrument or device mounted on the panel. (ii) Nameplates for panels shall be provided both in front and rear. (j) All local control panels shall be housed in air condition environment.		

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4.1	<u>CONTROL DESK</u> 4.1.1 Devices mounted on the desk shall be flush type. Devices shall be so mounted that their removal and replacement can be accomplished without interruption of services to others. 4.1.2 Desk shall be ergonomically designed to suit working on a 24 X 7 basis. Aesthetics, ergonomics and illumination shall be considered while positioning of the desk, large video screen and panels in control room. 4.1.3 Control desk shall be free standing floor mounting type of table-top design with compartments for locating the hardware. Desk shall be constructed from aluminum extrusion with high pressure laminate MDF board for work surface of approved colour. Aluminium structure shall be anodized or powder coated paint finish. Thickness of sheet shall not be less than 3 mm. 4.1.4 Monitors with retractable keyboard, emergency push buttons shall be provided on the desk. Desk shall be arranged in arc-like shape without any sharp edges. Edges shall be extruded PVC or rounded post-formed laminate. 4.1.5 Desk shall be of modular, scalable and industrially ruggedized design and shall have Telephones and Intercom connections. 4.1.6 Desk shall have concealed cable trays for wire dressing. 4.1.7 Design shall include Earthing bolts. 4.1.8 Back installed items shall be suitably concealed from front view. 4.2 <u>BACK UP PANEL</u> 4.2.1 Construction shall be from sheet steel of thickness not less than 3 mm. 4.2.2 Electrical upright Panel construction & design shall be similar to back up panel. Control switches, meters, indicators, synchronizer, excitation control switch, annunciation window etc. along with associated mimic diagram, as recommended, shall be provided for manual synchronization of generator.	

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4.2.3 Cabinets/Enclosure/Panels (a) Material of construction : Cold rolled steel sheet. (b) Thickness of Sheet : (i) 2.0 mm for faces supporting instruments / terminals. (c) Construction : Welded throughout as per approved National Standards. (d) Panel height : 2300 mm. (approx) (e) (i) Corners : 7 mm inner radius. (ii) Dimensional : a. In height & length - 3 mm. (iii) Tolerances : b. In height between adjacent sections - 2 mm. : c. Total for a group - 6 mm. (f) Doors : Double, recessed, turned back edges. (i) Thickness of Sheet : 2 mm. (ii) Hinges : Stainless steel. (iii) Door latches : Three point type. (iv) Door gaskets : Neoprene rubber on fixed frame to result dust proof/weatherproof enclosure. (v) Opening of the doors : Outward. (vi) Louvers : With removable wire mesh to ensure dust and vermin proof. (g) Color of interior : Brilliant white. (h) Colour external : RAL 7032.		

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<table><tr><td>(i)</td><td>Painting</td><td>:</td><td>Epoxy powder coated or better.</td></tr><tr><td>(j)</td><td>Gland plates</td><td>:</td><td>Removable 3 mm thick. (bottom)</td></tr><tr><td>(k)</td><td>Cable entry</td><td>:</td><td>Bottom.</td></tr><tr><td>(l)</td><td>Hardware</td><td>:</td><td>(i) Anti vibration pad- 15 mm.</td></tr><tr><td></td><td></td><td>:</td><td>(ii) Predrilled base channel ISMC - 10 or equivalent for all sides.</td></tr><tr><td></td><td></td><td>:</td><td>(iii) Stainless steel buff- finished 2 mm thick kick plate for all sides.</td></tr><tr><td></td><td></td><td>:</td><td>(iv) Stainless steel scratch strips along desk edges fixed with pan-head recessed screws.</td></tr><tr><td></td><td></td><td>:</td><td>(v) Rubber strips to ensure air tightness between kick plate and finished floor.</td></tr><tr><td></td><td></td><td>:</td><td>(vi) Lifting hook / Eye bolt.</td></tr><tr><td></td><td></td><td>:</td><td>(vii) Drawing pocket.</td></tr><tr><td></td><td></td><td>:</td><td>(viii) Door switch, lamps, thermostat, heaters and fans.</td></tr><tr><td>(m)</td><td>Enclosure Protection</td><td>:</td><td>As per environment condition of the area of installation. Refer section-1 of this vol.</td></tr></table>			(i)	Painting	:	Epoxy powder coated or better.	(j)	Gland plates	:	Removable 3 mm thick. (bottom)	(k)	Cable entry	:	Bottom.	(l)	Hardware	:	(i) Anti vibration pad- 15 mm.			:	(ii) Predrilled base channel ISMC - 10 or equivalent for all sides.			:	(iii) Stainless steel buff- finished 2 mm thick kick plate for all sides.			:	(iv) Stainless steel scratch strips along desk edges fixed with pan-head recessed screws.			:	(v) Rubber strips to ensure air tightness between kick plate and finished floor.			:	(vi) Lifting hook / Eye bolt.			:	(vii) Drawing pocket.			:	(viii) Door switch, lamps, thermostat, heaters and fans.	(m)	Enclosure Protection	:	As per environment condition of the area of installation. Refer section-1 of this vol.
(i)	Painting	:	Epoxy powder coated or better.																																															
(j)	Gland plates	:	Removable 3 mm thick. (bottom)																																															
(k)	Cable entry	:	Bottom.																																															
(l)	Hardware	:	(i) Anti vibration pad- 15 mm.																																															
		:	(ii) Predrilled base channel ISMC - 10 or equivalent for all sides.																																															
		:	(iii) Stainless steel buff- finished 2 mm thick kick plate for all sides.																																															
		:	(iv) Stainless steel scratch strips along desk edges fixed with pan-head recessed screws.																																															
		:	(v) Rubber strips to ensure air tightness between kick plate and finished floor.																																															
		:	(vi) Lifting hook / Eye bolt.																																															
		:	(vii) Drawing pocket.																																															
		:	(viii) Door switch, lamps, thermostat, heaters and fans.																																															
(m)	Enclosure Protection	:	As per environment condition of the area of installation. Refer section-1 of this vol.																																															
4.3 <u>LOCAL INSTRUMENT RACKS & ENCLOSURE</u>																																																		
4.3.1 General Requirements																																																		
(a) Devices located in the field shall be grouped and installed in the enclosure (Closed Rack) in outdoor areas such as Boiler area etc. and in Open Type Rack in covered areas such as TG Building.																																																		

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(b) Racks and enclosure shall be factory prefabricated & painted and shall complete with internal piping, tubing, manifold, isolation valves, blowdown valves, integral junction box, illumination etc., (c) No more than six instruments shall be grouped in a single rack/ enclosure. (d) Racks shall be installed above the tapping points for air, flue gas and coal air mixture application whereas for applications such as for water and steam, racks to be installed below the source point. (e) Attention shall be paid in the layout to avoid air traps in liquid piping and water accumulation in air/gas piping. (f) Welding of impulse lines shall comply with the provisions of the latest applicable ANSI Code for Pressure Piping. (g) Instrument piping and tubing shall be hydrostatically tested at one and one-half times the maximum system pressure except for low pressure and vacuum measurement for which the test pressure will be as per piping standard. (h) Service air connection shall be provided for continuous and intermittent purging of impulse pipe in dusty medium. Continuous purging shall be adopted for differential pressure measurement such as flue gas and coal air mixture application. Pressure measurement shall have only intermittent purging whenever required. In case of continuous purging, an air header shall be formed which shall receive service air through isolation valve and air filter regulator. Air shall be fed from the air header to both the impulse pipes near to take off points through isolation valves and flow regulators. Air header shall be constructed from stainless steel. Impulse pipe for such applications shall have a four-way valve. One port of the valve shall have an adaptor to connect flexible stainless steel braided nylon hose to the service air. Rating of the hose shall not be less than 10 Kg/sq.cm. Four way valve shall have two position operations. One position for service and other one for purging. Required pressure gauges shall be provided for monitoring of air pressure. Complete purging arrangement shall be integral to the enclosure and racks.		

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(i) Gate or ball type (full ported) instrument isolation valve and globe type blow down drain valve adequate for duty requirement and for withstanding continuous design pressure and temperature of main process medium shall be provided in the hook up plumbing. For process pressure equal or above 40 kg/ sq.cm single instrument isolation valve and double blowdown valves shall be used before connecting to blowdown header. Whereas for line pressure less than 40 kg/sq.cm, single instrument isolation valve and single blow down valves can be used before connecting to blow down header. Instrument manifolds shall be non integral and shall be installed close to the instrument. (j) Drawing No. PE-189-IN-SK-8004/P0 (Sheets 10) shall be referred for typical arrangement of Local instrument enclosure and rack. 4.3.2 Closed Instrument Rack (a) Enclosure shall be free standing type. Racks shall be adequately reinforced to ensure true surfaces and to provide support. Major load-bearing posts shall be suitably supported by gusset plates or moment members. (b) Enclosure outer shall be constructed from at least 3 mm thick steel plate and epoxy painted to shade gray. Base frame shall be made of ISMC 100 and black color finish. (c) 2" NB galvanized pipes shall be laid horizontally and supported at two end channels to mount transmitters at accessible height. Center posts or any member, which would reduce access, shall be avoided. (d) Double leaf interlocking front opening doors with three point locking shall be provided and shall be arranged for maximum possible access to the interior. Key shall be of identical for all enclosures. (e) Doors shall have concealed quick removal type pinned stainless steel hinges and locking handles. Gaskets shall be used between all mating sections to achieve dust and weather proof enclosure rated for IP-65 including the internal junction box.		

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(f) Removable type bulkhead plates of thickness not less than 6 mm shall be mounted at the racks with suitable high temperature gasket. Impulse lines within the enclosures shall be properly clamped. (g) All internal wirings between the instruments and junction box shall run through flexible conduits. (h) Racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Header shall be of 2" NB ASTM A 106, Sch-80 Gr. C installed at a slope of 1:25 and extended beyond the rack for connection to plant drain header. (i) Each rack shall be provided with one receptacle, light fixtures each at instrument & Junction box compartments with wire guard. 4.3.3 Open Instrument Rack (a) Rack shall be free standing type constructed from 6 mm thick steel channel frame provided with a canopy to protect the instrument from dripping water or falling objects and shall be epoxy painted. Rack Major load-bearing posts shall be suitably supported by gusset plates or moment members. Suitable protective grill shall be welded to the end-posts of the rack to outline a boundary beyond which no mounted equipment shall project. Canopy shall be of CRCA steel sheet of at least 3 mm thickness. Center posts or any member, which would reduce access, shall be avoided. (b) 2" NB galvanized pipes laid horizontally and supported at two end channels shall be employed at working accessible height for mounting of instruments. (c) All internal wirings between the instruments and junction box shall run through flexible conduits. No exposed wirings are admissible. (d) All racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Header		

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4.3.4	shall be of 2" NB ASTM A 106, Sch-80 Gr. C installed at a slope of 1:25 and extended beyond the rack for connection to plant drain header. Junction Box Junction boxes of metallic construction. (a) Junction box shall be provided at a dry compartment at one side of the enclosure/rack with front opening type door. Junction box shall be of sheet steel construction with thickness not less than 2 mm. Earth stud shall be furnished at rack for safety grounding. (b) Terminals shall be screwless cageclamp type of reputed make and 20% spare terminals shall be furnished in the junction box. <u>5.0 DISTRIBUTED CONTROL SYSTEM (DCS)</u> <u>5.1 SYSTEM FUNCTIONAL DESCRIPTION</u> 5.1.1 Integrated functionally & geographically distributed and hierarchically structured real time control (both binary and modulating), Data acquisition, Man machine interface, Historization units and Management Information System (MIS) system synthesized from one general family of identical interchangeable multifunction hardware has been envisaged. 5.1.2 System shall be highly reliable with the availability of not less than 99.7% with adequate redundancy and fault tolerant configuration. 5.1.3 The system shall be unitized and connectivity with other plant control system & Plant wide network has been envisaged. 5.1.4 Remote input output stations as a data concentrator for acquisition and monitoring of non critical parameters like Boiler metal temperature and Generator winding temperature etc, are foreseen. RIO shall be industrially ruggedized and shall be provided with integral air conditioner considering the harsh environment. 5.1.5 For Power supply to DCS system refer Volume V , Section-10.	

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5.1 <u>CONDUCTIVITY ANALYZER</u> 5.1.1 Sensor (a) Type of Cell : Flow thru'. (b) Conductivity Range : As per instrument schedule (c) Cell Constant : 0.01/0.1/1.0 depending upon range. (d) Temp. Compensation : Manual and Automatic (Integral) 0-100°C. (e) Process Connection : Screwed. (f) Wetted Parts : Electrodes-SS316L/ Insulators KYNAR/Viton. (g) Pressure Rating : 10 kg/cm². (h) Accessories : Vessel (SS 316) with ½" NPT connection. (i) Cable : Upto transmitter in flexible conduct. 5.1.2 Transmitter (a) Type : Microprocessor based, Single stream (b) Mounting : Flush Panel. (c) Protection Class : IP-55 or better. (d) Output : 4-20 mA DC (isolated). (e) Display : Digital Display in Engineering Unit, Alarm Status. (f) Zero/Span Adjustment : Front Panel Membrane type		

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	Keyboard. (g) Temp. Compensation : Manual or Automatic. (h) Diagnostic : Self diagnostic for electronics, electrode etc. (i) Alarm : Dual set point, hysteresis and time delay adjustable. (j) Enclosure : Die cast aluminium, epoxy coated. (k) Cable Termination : Internal (cable entry through conduit). (l) Accuracy : ± 1.0 % of measured range. (m) Response time : Less than 5 sec. (n) Stability : ± 1.0 % of output range / month non-cumulative. (o) Accessories : For cation conductivity- Dual Ion-Exchange column, resin, etc. (minimum 12 months' requirements).	
5.2	<u>pH ANALYZER</u>	
5.2.1	Sensor	
	(a) Type of Cell	: Flow thru'.
	(b) Range	: 0-14 pH.
	(c) Type of measurement	: Combination electrode.
	(d) Temp. Compensation	: Manual and Automatic (Integral) 0-100 °C.

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	(e) Process Connection : Screwed. (f) Measuring Electrode : Glass. (g) Pressure Rating : 10 kg/cm². (h) Accessories : Vessel (SS 316) with ½" NPT connection. (i) Cable : Upto transmitter in flexible conduct. (j) Preamplifier : Integral or separate. (k) Liquid Junction : Ceramic / Kyner or equivalent. 5.2.2 Transmitter : (a) Type : Microprocessor based, Single stream (b) Mounting : Flush Panel. (c) Protection Class : IP-55 or better. (d) Output : 4-20 mA DC (isolated). (e) Display : Digital Display in Engineering Unit, Alarm Status. (f) Repeatability : ± 1% or better. (g) Temp. Compensation : Manual or Automatic. (h) Diagnostic : Self diagnostic for "Calibration required"/ "Calibration O.K.", electrode checking etc. (i) Alarm : Dual set point, hysteresis and time delay adjustable.		

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(j) Enclosure (k) Cable Termination (l) Accuracy (m) Response time (n) Stability (o) Accessories 5.3 <u>SILICA ANALYZER</u> (a) Type (b) Output (c) Readout (d) Accuracy (e) Reproducibility (f) Calibration (g) Cycle time (h) Operating temperature (i) Mounting (j) Life of light source : Die cast aluminium, epoxy coated. : Internal (cable entry through conduit). : $\pm 0.2\%$ of FSD or better. : Less than 5 sec. : ± 0.001 pH /week. : Ultrasonic Electrode Cleaner, Buffer solution tablets. : : Colorimetric monitor, gravity / pumped feed Microprocessor based. : 4-20 mA DC (isolated) into 600 ohms. : Digital Indicating meter for direct readout. : $\pm 1\%$ of F.S.D or better. : $\pm 2\%$ of F.S.D. or better. : Manual & automatic. : Less than 10 min or better. : 0-45 °C . : Flush panel. : 9,000 hours (approx.).		

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5.6	(f) Drift	: 2 ppb/month or better.
	(g) Temp. Compensation	: Automatic up to 45 °C.
	(h) Response Time	: 1 minutes or better.
	(i) Mounting	: Flush Panel.
	(j) Alarm Facility	: 2 HI and 2 LO independently adj. over span.
	(k) Preferred Feature	: 2 Hi and LO alarm LED visible from front.
		: Power supply on/failure LED.
	(l) Accessories	: Chemical reagents for 12 months.
	<u>DISSOLVED OXYGEN ANALYZER</u>	:
	(a) Type	: Electro-chemical, Microprocessor based.
	(b) Range	: As per approved instrument schedule
	(c) Type of Cell	: Flow through sampling type (continuous).
	(d) Enclosure	: IP-55 or better.
	(e) Output	: 4-20 mA DC isolated to a load of 600 Ohms (minimum).
	(f) Temp. Compensation	: Automatic up to 45 Deg.C
	(g) Readout	: Digital Indicating meter.
	(h) Accuracy	: Better than $\pm 4\%$ of full scale for Transmitter.

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(i) Sensor Response Time (j) Mounting (k) Alarm Facility (l) Preferred Feature (m) Accessories 5.7 <u>CHLORIDE ANALYZER</u> (a) Type (b) Type of Cell (c) Enclosure (d) Output (e) Temp.Compensation (f) Ambient Temp. (g) Readout (h) Accuracy (i) Reproducibility (j) Detection Limit : 90% in 30 seconds or better. : Flush panel. : 2 HI & 2 LO independently adj. over span. : HI & LO Alarm LED visible from front. : Power supply on/failure LED. : In-built calibration facility. : Reagent Cabinet (if applicable). : Reagent Reservoir (if applicable). : : Electro-chemical, Microprocessor based. : Chloride Ion Selective Electrode. : IP-55 or better. : 4-20 mA DC isolated to a load of 600 Ohms. : Automatic with Pt 100. : 45 Deg. C : Digital Indicating meter. : ± 2% or better. : <3%. : 0.5 mg/l or better.		

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	(k) Analysis Time : 5 minutes (max). (l) Cycle time : Adjustable. (m) Calibration : Manual and automatic. (n) Mounting : Flush panel. (o) Alarms : 1 HI, 1 LO and 1 system alarm. (p) Control accessories : Sample level detector. : Reagent level detector. : Calibration solution level detector. : Automatic sample, rinse and drain valve. : Pump for reagent solution. : Pump for calibration solution. (q) Accessories : Reagent solution tank. : Calibration solution tank.	
5.8	<u>SAMPLE CONDITIONING SYSTEM</u>	
5.8.1	Sample conditioning system shall be designed and constructed to receive and condition all samples as required by the respective analyzers. This shall include all conditioning equipment mentioned herein:	
	(a) Sample filtering. (b) Primary and final sample cooling and temperature control. (c) Pressure reduction and control, as required. (d) Flow rate control.	

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10.0	<u>CONTROL & INSTRUMENTATION CABLE</u>	
10.1	Cables shall be flame retardant low smoke (FRLS) type. In hazardous areas cables of suitable R/L ratio shall be provided for intrinsic safety.	
10.2	Durable marking shall be provided on the surface of the cable at intervals not exceeding 5 mtrs. Marking shall include Manufacturer's name, Year of manufacture, Voltage grade, Type of cables (Conductor size & no. of pairs/ triads/type of compensating /extension cable), Insulation material, FRLS etc. Sequential length marking shall also be provided at every meter interval on outer sheath of cable.	
10.3	Standard seasoned wooden drum containing minimum 500 /1000 M $\pm$ 5% length. Drum shall be anti rodent, anti termite and smooth finish. Both end of cable shall be capped by means of non hygroscopic sealing material.	
10.4	<u>THERMOCOUPLE EXTENSION & COMPENSATING CABLE</u>	
	(a) Conductor : Solid conductor.	
	(b) Conductor size : 16 AWG (1.31 Sq. mm)	
	(c) Type : KX (Extension) (Chromel Alumel) RX (Compensating) (Copper-Copper alloy) JX (Extension) (Iron Constantan).	
	(d) Conductor Insulation : HR PVC Type-C (IS-5831,1984) 0.6 mm thick.	
	(e) Operating Voltage : 300V /500V RMS (Core to earth / core to core).	
	(f) Twisting : Pair twisted with lay of 60 mm (max)	
	(g) Twisting Direction : All pairs in the same direction. Lapped to form bunch with mylar tape.	

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	(h) Screen (Pair & Overall) : Aluminium mylar tape with a thickness of 28 μm (min.) for individual pair screen and 60 μm (min.) for overall screen with 100% coverage and 25% overlapped edges. Over the individual pair screening tape two laps of 0.05 mm thick (min.) polyester tape shall be applied with minimum overlap of 25%. Metallic side of the screen shall be in contact with drain wire. (i) Drain wire : Annealed tinned copper wire, stranded. Size 0.5 Sq. mm. (No. of strands/size:- 7/0.3mm) (j) Inner Sheath : Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties) HR PVC Type ST2 of IS-5831,1984 Thickness as per IS-1554Part-I 1976. (k) Rip Cord : Non metallic under sheath. (l) Armouring : GI wire/strip as per IS 3975. (m) Outer Sheath : Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties) HR PVC Type ST2 of IS-5831,1984 Thickness as per IS-1554Part-I 1976. (n) Filler : Non hygroscopic with FRLS property. (o) Temperature Range : Up to 85 °C. (p) Insulation at 20^o C : 100 MOhms/Km [Min]. (q) Capacitance at 800 Hz : 120 nf/km.	

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	(r) Cross talk : 60 dB. (s) Attenuation : 1.2 dB/Km (t) Codes & Standards : IEC 332-1. ANSI MC 96.1. IS-8784-1987. (u) Tests (i) Oxygen Index: Min.29 at room temp. (ASTM-D-2863) (ii) Acid Gas Gen.: Max.20% by weight as per IEC 754 Part-I (iii) Temp Index : Min 250 DEG C at 21 Oxy. Ind. (ASTM-D-2863) (iv) Smoke Density Rating : Max.60% (ASTM-D-2843). (v) Flammability Test : as per IEC 332 Part-I/IEEE-383 Swedish Chimney Test - SS-424-1475 F3. (vi) High voltage test Core to core- 1.5 kV for 1 min. Core to screen-1.0 kV for 1 min. (vii) Insulation Resistance 100 M Ohm/Km Min. (viii) Rodent & Termite repulsion test (Presence of lead shall be confirmed)	

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- (v) Conductor material & sheath color for thermocouple cable as per ANSI MC 96.1.

CABLE TYPE	OVERALL SHEATH COLOR	WIRE	SHEATH COLOR	CONDUCTOR MATERIAL
KX	Yellow	Positive	Yellow	Nickel / Chromium
		Negative	Red	Nickel / Aluminum
JX	Black	Positive	White	Iron
		Negative	Red	Constantan
RX	Green	Positive	Black	Copper
		Negative	Red	Copper Nickel Alloy

- (w) Durable printed or embossed numbering at regular interval of 50mm shall be provided for identification of pairs.

10.5 INSTRUMENTATION MULTI PAIRED SIGNAL CABLE

- (a) Conductor type : Stranded (7) annealed tinned copper.
- (b) Conductor size : 0.5/1.0/1.5 Sq.mm. (as required)
- (c) Conductor resistance : 39 Ω /Km/18 Ω /Km/12 Ω /Km.
- (d) Conductor Insulation : HR PVC Type-C (IS-5831,1984) 0.6 mm thick.
- (e) Operating Voltage : 300/500V RMS. (Core to earth/core to core)
- (f) Twisting : Twin twisted with lay of 60 mm.

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(g) Twisting Direction : All pairs in the same direction. Lapped to form bunch with mylar tape. (h) Screen (Pair & Overall) : Aluminium mylar tape with a thickness of 28 μm (min.) for individual pair screen and 60 μm (min.) for overall screen with 100% coverage and 25% overlapped edges. Over the individual pair screening tape two laps of 0.05 mm thick (min.) polyester tape shall be applied with minimum overlap of 25%. Metallic side of the screen shall be in contact with drain wire. (i) Analog signals- Individual pair & overall shield to be considered. (ii) Binary signals- overall shield to be considered. (i) Drain wire : Annealed tinned copper wire, stranded. Size 0.5 Sq. mm. (No. of strands / size:- 7 / 0.3mm) (j) Inner Sheath : Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties) HR PVC Type ST2 of IS-5831,1984 Thickness as per IS-1554, Part-I 1976 (k) Rip Cord : Non metallic under sheath. (l) Armouring : GI wire/strip as per IS 3975 (m) Outer Sheath : Extruded FRLS PVC (anti rodent, anti termite & moisture resistant properties).		

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HR PVC Type ST2 of IS-5831,1984. Thickness as per IS-1554, Part-I 1976. (n) (o) (p) (q) (r) (s) (t) Filler Temperature Range Insulation at 20 Deg.C Capacitance at 800 Hz Cross talk Attenuation Codes & Standards : Non hygroscopic with FRLS property. : 85 °C. : 100 MOhms/Km [Min] : 120 nf/km : 60 dB. : 1.2 dB/Km. : (i) IPCEA-S-61-402. (ii) BS 5308. (iii) IEC 332-1. (iv) ASTM-B-33. (v) IS-8130-1984. (vi) IS 1554 Part-1. (vii) IS 10810. (u) (v) Sheath color Tests : Inner- Black and Outer- Gray. (i) Oxygen Index: Min.29 at room temp. (ASTM-D-2863). (ii) Acid Gas Gen.: Max.20% by weight as per IEC 754 Part-I. (iii) Temp Index: Min 250 ° C at 21Oxy. Ind. (ASTM-D-2863).		

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(iv) Smoke Density Rating: Max.60% (ASTM-D-2843). (v) Flammability Test : as per IEC 332 Part-I. (vi) Swedish Chimney Test-SS-424-1475 F3. (vii) Insulation Resistance 100 M Ohm / Km Min. (viii) High voltage test Core to core- 1.5 kV for 1 min. Core to screen- 1.0 kV for 1 min. (ix) Rodent & Termite repulsion test (Presence of lead shall be confirmed). (w) Colour of core for Instrumentation Cable (As per IS-9938)																													
<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th style="width: 33%;">PAIR</th><th style="width: 33%;">CORE</th><th style="width: 33%;">COLOR</th></tr> </thead> <tbody> <tr><td>1st</td><td>1st</td><td>Blue</td></tr> <tr><td>1st</td><td>2nd</td><td>Red</td></tr> <tr><td>2nd</td><td>1st</td><td>Gray</td></tr> <tr><td>2nd</td><td>2nd</td><td>Yellow</td></tr> <tr><td>3rd</td><td>1st</td><td>Green</td></tr> <tr><td>3rd</td><td>2nd</td><td>Brown</td></tr> <tr><td>4th</td><td>1st</td><td>White</td></tr> <tr><td>4th</td><td>2nd</td><td>Black</td></tr> </tbody> </table>			PAIR	CORE	COLOR	1 st	1 st	Blue	1 st	2 nd	Red	2 nd	1 st	Gray	2 nd	2 nd	Yellow	3 rd	1 st	Green	3 rd	2 nd	Brown	4 th	1 st	White	4 th	2 nd	Black
PAIR	CORE	COLOR																											
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10.6 10.7 11.0 11.1	Above 4 Pairs, 4 Pairs making a unit shall have indelible printed colour coded bands like Pink for 1st unit, Orange for 2nd unit and Violet for 3rd unit and so on. In addition band marking, for example single band for 1st. unit, double band for 2nd. unit and so on, shall be provided on each conductor for identification of unit. Band marking on individual core shall be provided at regular intervals not exceeding 50 mm. Cables near high temperature zone shall be capable of withstanding high temperature and terminated in junction box / panel in normal temperature zone. Teflon insulated and sheathed thermocouple extension cables and copper conductor cables shall be used in high temperature zone. Conductor and sheath shall be extruded FEP (Teflon) as per VDE 0207 Part 6 and ASTM D 2116. These cables shall be pair, multipair, triad, multitriad and twisted & shielded. <u>CONTROL & POWER CABLE</u> Bidder shall refer to Volume IVB of the electrical specification for detail. <u>ERECTION HARDWARE</u> This section provides the general technical guidelines for the erection materials for instruments. All erection materials shall be of good quality and conform to the operating environment of the corresponding instrument. <u>ELECTRICAL ACCESSORIES</u> Electrical conduit and associated materials shall conform to the requirements of the articles which follow: (a) Rigid Steel Conduit (i) Conduits up to and including 25 mm shall be of 16 SWG and conduits above 25 mm shall be of 14 SWG. Minimum size of conduits shall be 19 mm. (ii) Each piece of conduit shall be straight, free from blister and other defects and covered with capped bushing at both ends.	

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(iii) All rigid conduit couplings and elbows shall be hot dip galvanized rigid mild steel in accordance with ANSI C 80.1 and UL6. The conduit interior and exterior surfaces shall have a continuous zinc coating with an over coat of transparent enamel or zinc chromate. Conduits shall be furnished in standard length of 3 meters, threaded at both ends. (iv) All conduit fittings shall conform to the requirements of ANSI C 80.4 and UL-514 where these standards apply. (b) Flexible Conduit (i) Flexible conduit shall be of three-layer construction of very high quality of lead coated steel. Outside and inside layer shall be reinforced with heat resistant material. (ii) Lead coating outside and inside of the conduit steel surface shall provide a non-corrosive characteristic particularly in acidic atmosphere. Besides flexibility, this shall be strong enough to stay at the desired profile without support and shall be durable and strong so as to offer sufficient mechanical protection. It shall also be fully liquid dust and air tight and shall withstand a continuous hydraulic pressure up to 2 Kg/ Sq. cm and temperature up to 200 °C. (c) Special Fittings (i) Conduit sealing and fittings shall be provided as required and shall be consistent with the area and equipment with which they are installed. (ii) Double locknuts shall be provided on all conduit terminations not provided with threaded lugs and couplings. Locknuts shall be designed to securely bond the conduit to the enclosure when tightened. Locknuts shall not loosen due to vibration.		

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11.1.1 Electrical Junction Box (a) Type of Enclosure : Dust tight & weatherproof conforming to IP 65. (b) Material : 3 mm sheet steel (c) Type of Cover : Solid unhinged with retention chain. (d) Paint : External - RAL 7032, Internal – Brilliant White. (e) Mounting : Surface (f) Cable Entry : 3 mm (min) Gland plate (g) Gasket : Neoprene (h) Grounding : Brass earth lug with green screw head External-2 nos , Internal-1no.M6. (i) Number of Drain Holes : Two at bottom capped. (j) Identification : Label for JB and Tags for cable. (k) Accessories : (i) Rail mounted cage clamp type screwless terminals with markers. (ii) Cable gland (iii) Ferrules (iv) Canopy at top 11.1.2 Cable Gland (a) Type : Double compression (b) Entry Thread : NPT		

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(c) Material : Brass (d) Finish : Cadmium Plated (e) Protection : IP 54 or better (f) Accessories : Neoprene gasket, locknuts, reducers etc. 11.1.3 Cable Tray (a) Material : Mild steel, slotted (b) Thickness : not less than 2.0 mm (c) Finish : Hot dip galvanized (d) Perforation : As per MFR standard (e) Cover : Suitable for tray 11.2 <u>PROCESS HOOK UP ACCESSORIES & SPECIFICATION</u> Material and rating of the hook up items shall suit the piping and fluid condition. Hook up materials shall be IBR certified for applicable cases. Bidder shall furnish hook up drawings and the drawings for open racks & closed racks for owner's approval. 11.2.1 Seamless Stainless Steel Pipe (a) Reference : ASTM A-312 TP 316 (b) Material Grade : TP 316 (c) Type : Seamless /Plain end (d) Size : ½" NB (e) Schedule : 40 (f) Standard Length : 5 meter		

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± 15 % for wall thickness. (h) Standard Length : 5 meter (i) Test : Flare, Hardness, Ball and Bubble Test. 11.2.4 Stainless Steel Tube Fittings (a) Reference : ASTM-A-182 (b) Type : Double ferrule double compression. (c) Material : 316 Stainless steel forged. (d) Ferrule : 316 Stainless Steel. (e) Type of Fittings : Male/female connector, elbow, cross /equal tee, straight connector, bulkhead union, ferrule etc. as required to suit installation. (f) Size : To suit SS tubing and NPT end connection. 11.2.5 C.S. Pipe (a) C.S. Pipe : ASTM-A 106 Gr. C (b) Material : Cold drawn seamless black C.S (c) Type : Seamless/Plain ends. (d) Size : ½" NB (e) Schedule : 80, 160, XXS as required. (f) Standard Length : 6 meter		

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11.2.6 C.S. Pipe Fittings (a) Reference : ASTM-A 105 / ANSI B16.11 (b) Type : Forged (c) Rating : 3000 lbs/6000 lbs/9000 lbs (d) Size : ½" NB (e) End connection : Generally socket weld. (f) Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc. 11.2.7 A.S. Pipe (a) Reference : ASTM-A 335 P22 AS PER ANSI B 36.10 (b) Material : Cold drawn seamless A.S (c) Type : Seamless / Plain ends (d) Size : ½" NB (e) Schedule : XXS (f) Standard Length : 5 meter 11.2.8 A.S. Pipe Fittings (a) Reference : ASTM-A 182 F22 AS PER ANSI B 16.11 (b) Type : Forged (c) Rating : 9000 lbs (d) Size : ½" NB		

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(e) End connection : Generally socket weld (f) Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc. 11.2.9 Carbon Steel Globe Valve (a) Reference : ASTM A-105 (b) Type : Globe (c) Construction : Forged Body Cadmium Plated. (d) End Connection : ½" Socket Weld (e) Rating : CL. 800 / CL. 2500 (f) Material : Body - Carbon steel Stem - Hardened Steel Plug - AISI 316 SS Seat- Stainless steel stellited (g) Packing : Teflon / Grafoil as required (h) Yoke : ASTM A105 (i) Handwheel : Carbon steel (j) Design standard : As per ANSI B 16.34 11.2.10 Stainless Steel Globe Valve (a) Reference : ASTM A-182 F316 (b) Type : Globe (c) Construction : Forged Body (d) End Connection : Socket Weld (e) Proof Pressure : 400 Kg/Cm2 (f) Material : Body - Stainless steel		

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(c) Construction (d) End connection (e) Accessories 11.2.13 Instrument Valve Manifold (f) Type (g) Mounting (h) Construction (i) Material (j) Ports (k) Rating (l) Operating Temperature (m) Packing (n) Seat & Stem (o) Plug (p) Handle Bar (q) Connection (r) Accessories : Drilled from bar stock : 3 nos. ½" socket weld end : Vent valves (i) Two valve manifold (ii) Five valve manifold : Remote 2" Pipe Mounting : Single block (bar stock) : Forged body and bonnet AISI 316 stainless steel. : 1/2 " NPT (F) : 420 Kg/Sq. cm at ambient : (-) 30 to (+) 170 Deg C : PTFE Wafer : AISI 316 SS : AISI 316 SS free to turn on stem/17-4 PH. : AISI 316 SS : Straight (i) Plugs for all ports. (ii) Mounting Bracket , bolts , nuts.		

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11.3	<u>PNEUMATIC HOOK UP ACCESSORIES</u>		
11.3.1	Air Header :		
	(a) Technical Particulars	: For Panel For Field	
	(b) Material of Construction	: Stainless steel	Stainless steel
	(c) Inlet Connection	: 2" NPT (M)	1" NPT (M)
	(d) Header Take-off	: Stainless steel	Stainless steel
	(e) Take off connection	: 1 / 2" NPT (M)	1 / 2" NPT (M)
	(f) Tube Take-off	: Tube adapter on valve	Tube adapter on valve
	(g) Drain	: SS drain valve at lowest point	SS drain valves at lowest poin
11.3.2	Seamless Stainless Steel Tube		
	(a) Reference	ASTM A-269 TP 316	
	(b) Material Grade	TP 316	
	(c) Size	¼" OD X 0.049" wall thickness.	
	(d) Type	Cold drawn annealed, pickled, passivated, de-scaled, ,hydraulically cleaned seamless tube.	
	(e) Properties	The tube shall be free from scratches and suitable for bending and capable of being flared by hardened and tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80.	
	(f) Test Pressure	400 Kg/Sq. cm	

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	(g) Tolerance ± 0.13 mm for outside diameter ± 15 % for wall thickness (h) Standard Length 5 meter (i) Test Flare, Hardness, Ball and Bubble Test	
12.0	<u>SPECIAL TOOLS & TACKLE AND TEST EQUIPMENT FOR DCS/PLC AND OTHER SYSTEMS</u>	
12.1	Bidder shall supply a complete set of new, unused and reliable type of special tools and tackle and test equipment which are necessary or convenient for erection, commissioning, maintenance and overhaul of the plant and equipment provided under this specification.	
12.2	The tools & tackle and Test Equipment shall be shipped in separate container, clearly marked with names of the equipment for which they are intended.	
12.3	Bidder shall furnish list of tools & tackle and test equipment proposed to be supplied along with the bid.	

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7.2 INSTRUMENT ACCURACY, STANDARD SCALES AND RANGES

7.2.1 Instrument Accuracy

Instruments shall meet the following general requirements:

- (a) Pressure measurement shall be linear with respect to the measured pressure.
- (b) Flow meter shall meet the specified accuracy criteria when operating between 25 and 100 % of full-scale flow. The accuracy shall include the effect of errors in the differential head measuring device, square root converter and signal generator.
- (c) Level measurement shall be linear with respect to the measured level based on a water specific gravity of 1.00.
- (d) Wherever the measured parameter is influenced by process pressure & temperature, required compressibility correction shall be introduced. Following compensation ranges shall generally be applied:

SR. NO.	MEASUREMENT	TEMPERATURE RANGE DEG.C	PRESSURE RANGE KG/CM ²
(i)	Feed Water Flow	100 to 300	
(ii)	Secondary Air Flow	0 to 400	

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SR. NO.	MEASUREMENT	TEMPERATURE RANGE DEG.C	PRESSURE RANGE KG/CM ²
(iii)	Individual Coal Mill Primary Air Flow	0 to 200	
(iv)	Main Steam Flow	200 to 600	50 to 300

- (e) Temperature compensation shall produce corrections over a flow range from 10 percent to 100 percent of maximum flow subject to a plus or minus tolerance of one-half of one percent of the maximum flow.

7.2.2 Instrument Scale Displays

- (a) All displays shall be in engineering units. Instrument scales displayed on screen will have graduations with scale divisions based on multiples of 10. The smallest division shall preferably be a whole number approximately 1% of the scale range if not otherwise impracticable.
- (b) Pressure instrument shall have the unit suffixed with 'a' or 'g' to indicate absolute or gauge pressure, respectively.
- (c) Scales and charts of all instruments shall have linear graduations.

7.2.3 Instrument Ranges

Instrument range shall be selected to have the normal reading, preferably between 50% and 70% of full scale for linear parameters and 70% to 80% for flow measurements. Deviation indicators shall have the null position at mid scale. The normal operating parameter shall be identified with a clear green mark.

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7.6.2	Enclosures shall be adequately sized so that the maximum permissible temperature rise above 50 °C ambient is 10 °C (maximum).	
7.6.3	Enclosures design shall also take into account greatest possible personnel safety.	
7.7	<u>ELECTRICAL NOISE CONTROL</u>	
7.7.1	Equipment furnished by Bidder shall incorporate necessary techniques to eliminate problems caused by electrical noise interferences and power line borne surges encountered in power plant environment. Equipment, which are vulnerable to electrical noise interference or surge shall be suitably immunized to eliminate possible problems.	
7.7.2	Bidder shall be responsible for implementation of the shielding, input balancing, ripple filtration and grounding for field inputs to achieve installation with minimum noise coupling.	
7.7.3	Radiated immunity test shall be in accordance to IEC 801.3.	
7.8	<u>SURGE-PROTECTION FOR SOLID STATE EQUIPMENT</u>	
7.8.1	All solid-state equipment shall be able to withstand the surges inherent in a powerhouse environment. Equipment shall be designed to successfully withstand surges without damage to components and/or wiring on application of surge wave whose shape and characteristics are defined in ANSI publication C37.90-a (IEEE-472-1974) entitled "Guide for Surge Withstand Capability (SWC) Tests".	
7.8.2	To immunize the system against surge, coupling free wheeling diodes, surge suppressors, opto-galvanic isolators shall be used as required.	
7.9	<u>BURN-IN AND ELEVATED TEMPERATURE TEST</u>	
	Solid-state equipment/system shall be certified to be tested for a minimum period of 168 hours continuously under power. Solid-state logic systems shall be subject to the elevated temperature test and burn-in test as complete assemblies.	

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7.9.1 Elevated Temperature Test

- (a) During the first 48 hours the ambient temperature shall be maintained at 50°C and the equipment shall be made to repeatedly perform operations it will be expected to perform in service with loads on various components being equal to those which will be experienced in actual service.
- (b) The 48 hours test period shall be continuous but shall be divided into four 12-hour segments. The power supply voltage during each 12 hours segment shall be nominal voltage for 11 hours; followed by 110 percent of nominal voltage for 30 minutes; followed by 90 percent of nominal voltage for 30 minutes.
- (c) During the elevated temperature test the cubicle doors shall be kept closed and inside temperature in the zone of highest heat dissipating component/ module shall be monitored. Temperature rise inside the cubicle should not exceed 10 Deg.C above the ambient temperature of 50 Deg.C.
- (d) Solid-state logic systems shall be subject to the elevated temperature test and burn-in test as complete assemblies. Testing of individual components or modules shall not be acceptable.

7.9.2 Burn in Test

The 48 hours elevated temperature test shall be followed by 120 hours of burn in test at normal operating temperature. This test shall also be conducted as per above procedure.

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9.0 PROCESS CONNECTION & INSTRUMENT HOOK UP

9.1 Instrument connection to the process system (piping, vessel etc.) shall be according to the process & piping specification upto and including the root valves. Root valves shall be installed as close as possible to the piping or vessel. Each instrument shall have its own independent connection to the process except for instruments located on standpipe. Each instrument shall be connected independently to the standpipe through isolation valve.

9.2 Isolation and blowdown drain valves adequate for duty and capable of withstanding continuous design condition of main process shall be provided. Instrument blow down valve near to the instrument shall be of gradual opening type. For process pressure equal or above 40 kg/ sq.cm double blowdown valves shall be used connecting to blowdown header. Instrument manifold /gauge valve shall be installed close to the instrument.

9.3 The nominal size of the takeoff connections on line shall not be less than NPS ½” for source conditions not in excess of either 900 psi or 425°C and NPS ¾” (for adequate physical strength) for design conditions exceed either of these limits. Where the size of the main is smaller than the limits given above, the takeoff connections shall not be less than the size of the main line.

9.4 Process connection for instruments lines and vessels shall be in accordance to standards such as ASME or other recognized international standards. Table below indicates the type of connection generally to be used.

SR. NO.	INSTRUMENTS	EQUIPMENT/PIPE SIDE	INSTRUMENT SIDE
(a)	Level Instruments		
	(i) Internal Displacer	4” – Flanged.	4” – Flanged.
	(ii) External Displacer	2” – Flanged.	2” – Flanged.
	(iii) Level gauge	¾” – Flanged.	¾” – Flanged.

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SR. NO.	INSTRUMENTS	EQUIPMENT/PIPE SIDE	INSTRUMENT SIDE
	(iv) DP Type	½" (min.) - welded 1" – welded for vessel like HP heaters, LP heaters, De-aerator etc. application.	½"- NPT.
	(v) External cage Level switch	1"- welded.	1"- welded.
(b)	Flow Instruments		
	(i) DP Type	½" - welded in general. 1" – welded for high pressure/ temperature main steam, feed water, PRDS etc. application.	½" – NPT.
(c)	Pressure Instruments		
	(i) Conventional	½" (min.)-welded 1"- welded for high pressure/ temperature main steam, feed water, PRDS etc. application.	½" – NPT.
	(ii) Diaphragm type-HFO application	3"- Flanged.	3"- Flanged.

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SR. NO.	INSTRUMENTS	EQUIPMENT/PIPE SIDE	INSTRUMENT SIDE
(d)	Temperature Instruments		
	(i) Thermowell	Generally - M 33 X2 (M). 1½" Flanged- For air /FG path application.	½" NPT.
(e)	Analyzer		
	(i) Liquid analyzer	½" - 1" – welded.	½".

9.5 Size of impulse pipe for pressure measurement in air and flue gas duct path of boiler shall not be less than ¾" NB.

9.6 Separate stubs and take-off points with thermo well/root valves shall be provided for performance guarantee test.

9.7 Impulse pipes shall be clamped at suitable interval not exceeding 1.5 meter. Process pipe shall not be used for supporting the impulse pipe.

9.8 Fittings shall conform to ANSI B 16.11. Threads of piping component shall be of tapered construction.

9.9 Instrument blow down header shall in no case be lower than the material grade ASTM A 106 Gr. C.

9.10 Impulse pipe shall be laid at least with slope of gradient 1:10 to avoid any air pocket or water accumulation.

9.11 Expansion loop shall be provided at least at every 2.5 meter interval without affecting the gradient of slope in long run impulse pipe to avoid stress on the piping.

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9.12 9.13 9.14 9.15 9.16 9.17	Siphon shall be provided in the impulse pipe or tube to protect the instruments where fluid temperature is 100 °C or more.	
	Orientation of tappings shall be as follows :	
	(a) For liquid service within 45° at lower half of the pipe horizontal plane.	
	(b) For gas service within 90° at upper half of the pipe horizontal plane.	
	(c) For steam service within 45° at upper half of the pipe horizontal plane.	
	As a rule tap orientation of high and low pressure side should be parallel and symmetrical.	
	Pressure & Differential pressure instruments in steam and liquid services shall be located below the taps and the piping shall be sloped to avoid formation of air pocket.	
	Pressure & Differential pressure instruments in air and flue gas service shall be located above the taps and the piping shall be sloped back to process to avoid formation of any liquid.	
	Impulse pipe including taps for furnace, flue gas and coal mill application shall be provided with air purge connection. Differential instruments for such application shall have continuous and as well as intermittent purging. Whereas, pressure measurement shall have only intermittent purging.	
	Material of impulse pipe for the instruments mounted on rack and enclosure shall be same as that of main process pipe except stainless steel tube of Gr. 316H or better shall be provided for connection in between impulse pipe (from tee connection on impulse pipe) and instrument manifold valve & instruments. Impulse pipe, tubes, fittings and accessories shall have the same design pressure and temperature applicable for the related main pipe.	

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10.0	<u>POWER SUPPLY SYSTEMS</u> 10.1 Instrumentation power supply system shall include all conditioning equipment required to accommodate normal variations in the electrical supply. All panels and cabinets shall accept redundant power feeds from two different sources. 10.2 Type of power supply systems envisaged are as follows: (a) 240V AC UPS. (b) 24V DC battery system. The battery system shall be dual floating with each stream having its own float cum boost charger. Care shall be taken so that the control system is not damaged during boost charging and also that the cables are properly sized so that the voltage drop does not cause the terminal voltage at the consumer end to fall below the minimum recommended value.	
1.0	<u>ENVIRONMENTAL CONSIDERATIONS</u> 1.1 I&C components should operate properly with no degradation in expected lifetime or in operation parameter in the normal power plant environment. C&I system shall be designed considering all the operating conditions which may be encountered during installation and operation. 11.2 <u>TEMPERATURE</u> 11.2.1 Where the environmental extreme exceeds the capabilities of the selected system, Bidder should take appropriate steps to control the environment. 11.3 <u>HUMIDITY</u> I&C system shall be designed to withstand the humidity limits specified for the project. Condensation shall not be allowed to form in the cabinets nor should water be allowed to be admitted through conduit entering the cabinets from top or sides.	

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11.4	<u>ATMOSPHERIC CONTAMINATION</u> Particulate contamination from fly ash and coal dust and gaseous contaminants such as SO₂ and other flue gas constituents in the coal fired plant are foreseen. This hazard shall be taken into design considerations.	
11.5	<u>VIBRATION</u> Design of the systems shall include features such as locking devices, anti vibration pads etc, to withstand vibration. In general, I&C equipment shall be installed away from the vibration zone.	
11.6	<u>LIGHTNING</u> Protection against lightning shall be considered by providing proper grounding, metal oxide arrestors, spark gap lightning arrestor, optical isolator and isolation transformer.	
12.0	<u>SECURITY</u> 2.1 Door lock shall be provided in all Panels, Cabinets and Enclosures. 12.2 System mode key switch or password to prevent tampering of system program. 12.3 Redundant elements of the system shall not be exposed to the common hazards. For example routing of the redundant network cable through separate cable raceway, using separate cabinet/separate rack for redundant controller and redundant IO modules.	

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	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
CONTROL PANELS SPECIFICATION		

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7.9.1	Elevated Temperature Test (a) During the first 48 hours the ambient temperature shall be maintained at 50^o C and the equipment shall be made to repeatedly perform operations it will be expected to perform in service with loads on various components being equal to those which will be experienced in actual service. (b) The 48 hours test period shall be continuous but shall be divided into four 12-hour segments. The power supply voltage during each 12 hours segment shall be nominal voltage for 11 hours; followed by 110 percent of nominal voltage for 30 minutes; followed by 90 percent of nominal voltage for 30 minutes. (c) During the elevated temperature test the cubicle doors shall be kept closed and inside temperature in the zone of highest heat dissipating component/ module shall be monitored. Temperature rise inside the cubicle should not exceed 10 Deg.C above the ambient temperature of 50 Deg.C. (d) Solid-state logic systems shall be subject to the elevated temperature test and burn-in test as complete assemblies. Testing of individual components or modules shall not be acceptable.	
7.9.2	Burn in Test The 48 hours elevated temperature test shall be followed by 120 hours of burn in test at normal operating temperature. This test shall also be conducted as per above procedure.	
7.10	<u>PANELS, CUBICLES AND ENCLOSURES</u>	
7.10.1	General (a) All panels, cubicles and enclosures shall be furnished complete with integral piping, internal wiring, convenience outlets, internal lighting, grounding, ventilation, space heating, vibration isolating pads and other accessories.	

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Unless otherwise specified cable entry for panels/desks/cabinets shall be through bottom via glanding plate. Fireproof seal shall be used to seal the bottom to prevent entry of dust. (b) Panels and cabinets shall be constructed from steel sheet reinforced as required to provide true surface and adequate support for devices mounted thereon. Thickness of the steel plate shall conform to the requirements of UL 50 or equivalent standard. Panels and cabinets shall be of adequate strength to support mounted components during shipment and to support a concentrated load of 100 Kilograms on their top after erection. (c) Panel/cabinet shall have eyebolt on top for lifting. 7.10.2 Surface Preparation and Painting Sheet metal exterior steel surfaces shall be sand blasted, ground smooth and painted as specified below: (a) Suitable filler shall be applied to all pits, blemishes and voids in the surface. The filler shall be sanded so that surfaces are level and flat; corners are smooth and even. Exposed raw metal edges shall be ground burr-free. The entire surface shall be blast clean to remove rust and scale. Oil, grease and salts etc. shall be removed from by one or more solvent cleaning methods prior to blasting. (b) Two spray coats of epoxy primer surface shall be applied to all exterior and interior surfaces, each coat of primer surface shall be of dry film thickness of 1.5 mil. A minimum of two spray coats of final finish colour (Catalyzed epoxy or polyurethane) shall be applied to all surface of dry film thickness 2.0 Mil. The finish colours for exterior and interior surfaces shall conform to the following shades: (i) Exterior – RAL 7032. (ii) Interior - Brilliant White.		

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(c) Paint films, which show sags, cheeks, blisters, teardrops, fat edges or other painting imperfections shall not be acceptable. 7.10.3 Wiring Wiring within the panels shall conform to NEC standards and shall be factory installed and tested at the works. All interior wiring shall be installed neatly. Features shall not be limited to the following: (a) All spare contacts of relays, switches and push buttons shall be wired up to the terminal blocks. (b) Each wire shall be identified at both ends with wire designation as per approved wiring diagram. Heat shrinkable type ferrules with indelible computerized print shall be used with cross- identification. (c) Wire termination shall be made with insulated sleeve and crimping type lugs. All external connections shall be made with one wire per terminal. Wire shall not be spliced or tapped between terminals. Open-ended terminal lugs shall not be used. (d) Internal wiring should be terminated uniformly on one side of the terminal block leaving the other side available for termination of outgoing cables. (e) Thermocouple lead wires, analyzer measuring lead wires, or any other lead wires carrying measuring signal of the order of low milli volt or micro volt shall be electrically and physically isolated from other AC and DC wiring. (f) All low-level signal cables shall be separately bundled from control cable. (g) Wires shall be dressed and run in troughs with clamp-on type covers. Wirings shall be neatly bunched in groups by non-metallic cleats or bands. Each group shall be adequately supported along its run to prevent sagging or strain on termination. (h) Shield wires shall be terminated on separately.		

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(i) Common connections shall be limited to two wires per terminal. (j) Wiring to door mounted devices shall be provided with multi-strand wires of (49 strands minimum) adequate loop lengths of hinge-wire so that multiple door openings will not cause fatigue to the conductor. (k) Wiring shall be arranged to enable instruments or devices to be removed and/or serviced without disturbing the wiring. No wire shall be routed across the face or rear of any device in a manner, which will impede the opening of covers or obstruct access to leads, terminals or devices. (l) Panel internal wiring shall follow distinct colour-coding to segregate different voltage levels viz. 24V DC, 48V, 110V AC, 240V AC, 220V DC etc. (m) Panels/cabinets /desks shall be provided with removable gasketed cable gland plates and cable glands. Split type grommets shall be used for prefab cables. (n) Wire shall be multistranded annealed flexible high purity copper conductor with heat resistant FRLS PVC insulation and shall pass vertical flame test per IPCEAS-1981. (o) Wire sizes used for internal wiring shall not be lower than the followings: (i) Control wiring : 1.5 Sq.mm (switches, pushbuttons etc.) (ii) Power supply/receptacle : 2.5 sq. mm or higher as /illumination wiring per load/ (iii) 4-20mA DC current : 0.5 Sq. mm and low voltage signal upto 24V DC		

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(p) Identification of conductors shall be done by insulation color-coding identified on drawings or by printed wiring lists. 7.10.4 Grounding (a) System cabinet AC and DC ground shall be electrically isolated from each other and also electrically isolated from the Instrumentation signal ground. All the above ground shall be individually connected to the single point on the ground pit. Dedicated redundant earth pit shall be provided which shall be away from the HV equipment. This earth pit shall not be shared with other electrical equipment ground and shall also be insulated from other electrical system ground to ensure single point grounding of the system. Grounding resistance shall be better than 1.0 ohm. IEEE guideline shall be followed while designing the grounding system. (b) Panels and cabinets shall be provided with a continuous tinned copper ground bus bar of minimum 25 mm x 6 mm cross section, extending along the entire length of the panel/desk/cabinet assembly. The ground bus shall be bolted to the panel structure and effectively ground the entire structure. (c) The panel/desk/enclosure /JB ground shall have two (2) bolt drilling with GI bolts and nuts at each end to connect to GI/ copper flat ground riser by means of insulated copper ground cable of required cross section with lug. (d) Circuits requiring grounding shall be individually and directly connected to the panel ground bus. (e) For electronic system cabinets, the electronic system ground bus shall be similar but insulated from the cabinet and shall be separately connected to the system ground. Signal cable shields shall be grounded at the panel end only and shall not be left open. The ground in between panels of a shipping section shall be firmly looped.		

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(f) Electrical meters, relays, transmitters and switching devices, operating at a voltage less than 50V may be grounded through the steel structure. 7.10.5 Panel/Cabinet/ Desk/Enclosures Environmental Protections (a) Panels, cabinets, desks, distribution boxes, junction boxes, terminal boxes and all other field mounted equipment / enclosures shall suit the environmental condition of the area and shall not be inferior than the requirement indicated in the following table: <table border="1"> <thead> <tr> <th>SR. NO.</th><th>LOCATION</th><th>ENCLOSURE TYPE</th></tr> </thead> <tbody> <tr> <td>(i)</td><td>Indoor type non- ventilated enclosure in non-hazardous area</td><td>IP-54.</td></tr> <tr> <td>(ii)</td><td>Indoor type ventilated enclosure in non-hazardous area</td><td>IP -42.</td></tr> <tr> <td>(iii)</td><td>Enclosure in Air conditioned area</td><td>IP-22 with suitable canopy at top to prevent ingress of dripping water.</td></tr> <tr> <td>(iv)</td><td>Outdoor type in non-hazardous areas</td><td>IP-55.</td></tr> <tr> <td>(v)</td><td>Outdoor in hazardous areas</td><td>As per requirements of the NEC Code for the location.</td></tr> </tbody> </table> 7.10.6 Terminal Blocks (a) Terminals shall be chromated galvanized DIN rail mounted screw less cage clamp type. Terminals shall have screwed connection for conductor cross-section above 2.5 mm². Terminal blocks shall conform to IEC 947-7-1.			SR. NO.	LOCATION	ENCLOSURE TYPE	(i)	Indoor type non- ventilated enclosure in non-hazardous area	IP-54.	(ii)	Indoor type ventilated enclosure in non-hazardous area	IP -42.	(iii)	Enclosure in Air conditioned area	IP-22 with suitable canopy at top to prevent ingress of dripping water.	(iv)	Outdoor type in non-hazardous areas	IP-55.	(v)	Outdoor in hazardous areas	As per requirements of the NEC Code for the location.
SR. NO.	LOCATION	ENCLOSURE TYPE																		
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(b) The characteristics of the terminal blocks shall be as follows: (i) High contact force, independent of conductor cross-section and large contact surface area. (ii) Self-loosening protection. (iii) Resistant to thermal aging and vibration. (iv) Low and constant voltage drop. (c) Tension spring shall be made of high quality, non-rusting, acid-resistant steel. The current bar shall be of tin-lead plated copper or brass. (d) Terminals shall be of non flammable suitable thermoplastic material such as polyamide. (e) Terminal blocks shall be mounted vertically in panels and cubicles with clearance for at least 100 mm between two sets and between wall and terminal block. (f) Terminal blocks shall be provided with white marking strips/self-adhesive marker cards. Power terminals shall have protection covers. (g) At least 20 percent spare unwired terminals shall be provided for all panels/cabinets /desks /junction box etc. This shall be in addition to 20% spare wired terminals of spare IO channels and 10% wired spare modules. (h) Bottom of the terminal block shall be at least 200 mm above the cable gland plate for bottom entry type panels. (i) For extending 24 V DC supply to panels, the size of the terminals shall be decided based on voltage drop and not based on current. (j) Other requirements of the terminal blocks are as follows:		

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(i) The last block in a rail-mounted assembly shall be closed with an end plate and end bracket. (ii) For visual and electrical separation of terminal groups, partition plates shall be provided, which can be push fitted after forming an assembly. (iii) Design shall permit testing of incoming and outgoing signals by using suitable test plug and socket without disconnecting the cable connections. (iv) It shall be possible to use jumper plugs through the test plug socket to connect adjacent terminals. (v) Where more than one connection to a terminal block is required, two tier terminals shall be used. (vi) Terminal blocks shall be of different colours depending on voltage levels. 7.10.7 Nameplates and Labels (a) Each item shall have permanently attached to it, in a prominent position, a rating plate of non-corrosive material upon which is to be engraved the manufacturer's name, equipment, type/model number, range, serial number, together with details of the loading conditions under which the item of plant in question has been designed to operate. (b) Such nameplates or labels are to be of white non-hygroscopic material with engraved black lettering, or alternatively of transparent plastic material with suitably colour lettering engraved on the back. (c) The nameplates shall be held by self-tapping screws. The size of nameplate shall be approximately 20 mm x 75 mm for equipment and 40 mm x 150 mm for the panels.		

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(d) Items of plant such as valves, which are subject to handling, are to be provided with an engraved chromium plated nameplate or label with engraving filled with enamel, suitably mounted or affixed with strong rustproof chain

(e) All such nameplates, instruction plates, lubrication charts etc. shall be with English inscriptions. exemption

8.0 METERING BASES AND CHART UNITS

The following system of units shall be followed for various displays and scales unless otherwise mentioned:

(a)	Pressure	:	Kg/cm ² .
(b)	Differential Pressure	:	mm of H ₂ O column/Kg/cm ² .
(c)	Draught	:	mm of H ₂ O column.
(d)	Vacuum	:	Kg/cm ² (abs)/mm of Hg column.
(e)	Temperature	:	Degree Celsius (°C).
(f)	Flow (Steam, Water)	:	Tonnes/hr, M ³ /Hr.
(g)	Flow (Oil)	:	M ³ /Hr, Litter/Hr.
(h)	Flow Air	:	Tonnes/hr/M ³ /Hr.
(i)	Density	:	gms/c.c.
(j)	Level	:	mm/%.
(k)	Conductivity	:	Siemens/cm.
(l)	Gas Analyzer	:	Percentage by weight or as specified in respective case.
(m)	Dissolved Oxygen/Silica /Sodium	:	ppm /ppb.

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1.0 SCOPE

This specification covers the Design, Manufacture, Inspection and Testing at the manufacturer's works, proper packing for transportation and delivery to site, supervision, erection, and commissioning at site of Local Panels required for control and monitoring of the Auxiliary Plant & Equipment.

2.0 CODES AND STANDARDS

2.1 All the equipments specified herein shall comply with the requirements of the latest issue of the relevant National and International standards.

2.2 As a minimum requirement, the following standards shall be complied with:

- a) IS-6005 : 1998 : Code of practice for phosphating of iron and steel.
- b) IS-5 : 2007 : Colors for ready mixed paints and enamels.
- c) IS-1248:2003 : Direct Acting Indicating Analog Elec Measuring Instruments.
- d) IS/IEC 60947:Part 1:2004 : Low Voltage switchgear & control gear: Part-I (General Rules)
- e) IS-8828:1996 : Circuit breaker for household and similar installations.
- f) IS-13947 (Part-I):1993 : Low Voltage switchgear & control gear : Part-I (General Rules)
- g) ISA-18.1:1979 : Annunciator Sequences and Specification
- h) NFPA-496:2003 : Purged & Pressurised Enclosure for Electrical Equipment in Hazardous Locations.

3.0 TECHNICAL REQUIREMENTS**3.1 Panel Construction**

3.1.1 The local panels shall house the secondary instruments, annunciation system, Single loop controller, Control switches / push buttons, indicating lamps/LED cluster, relays, timers and other devices required for operation and monitoring of the equipment locally.

3.1.2 The panels shall be of free standing type either welded construction on angle iron (minimum section of 50 x 50 x 4 mm) structure or folded construction by sheet metal formation depending upon the equipments to be mounted on it. The panels shall be robustly built and stiffeners as necessary shall be provided.

3.1.3 The panel shall be suitably reinforced to ensure adequate support for all instruments mounted thereon. All welds on exposed panel surfaces shall be ground smooth.

3.1.4 The salient features of construction shall be:

Sheet material: Cold rolled sheet steel

Frame thickness: Not less than 3.0mm

Enclosure thickness: Not less than 3.0 mm for load bearing sections (Mounted with instruments)
2.0 mm for doors and Not less than 2.0 mm for others

Panel Height: Not less than 2365 mm (Refer data sheet-A (No. PES-145A-DS1-0)

Gland plate thickness: 3.0mm

Base channel: ISMC 100 with anti-vibration mounting & foundation bolts.

3.1.5 The panel shall be provided with rear doors with integral lockable handle. The door when locked shall be held at minimum three places. The door width shall not be more than 550mm. The doors shall be provided with suitable stiffeners to prevent buckling. The handle shall be on the right side of the door. The door shall be removable type with concealed hinges to facilitate maintenance work. Suitable pocket inside the door shall be provided for keeping the drawings / documents. Double door shall be provided with suitable glass windows, as per the requirement.

3.1.6 Suitable neoprene gasket shall be provided on all doors and removable covers. Suitable ventilation system along with louvers shall be provided at bottom and top of the doors covered with removable wire mesh.

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3.1.7 The class of protection shall be in accordance with IP-55 unless otherwise specified in the data sheet – A (No. PES-145-54A-DS1-0).

3.1.8 All steel surfaces shall be cleaned by sand / pellet blasting, treated for pickling, degreasing and phosphating etc. by seven tank method. The panel shall have a high quality finish and appearance. The panel shall be painted with two coats of primer followed by two coats of epoxy / synthetic enamel based final paint of color shade and finish as given in data sheet-A (No. PES-145A-DS1-0). Minimum thickness of the paint shall be 85 microns for external paint and 70 microns for internal paint.

3.1.9 The cable glands of the required size and type as given in data sheet-A (No. PES-145A-DS1-0) shall be supplied alongwith the Panel.

3.1.10 All operable and indicating devices shall be mounted on the front of the panel while aux. Relays / timers MCBs etc. required for realization of control logics shall be mounted on a mounting plate inside the panel. Auxiliary relays and timers etc. shall be grouped according to the control function.
No operable or indicating devices shall be mounted below 750 mm and above 1800 mm (w.r.t. finished ground level). The devices shall be located in such a way so as to ensure easy access for operation / maintenance.

3.1.11 Single / dual control power supply feeders of voltage class as specified in data sheet-A (No. PES-145A-DS1-0) shall be provided by the purchaser. In case redundant power supply feeders are provided then auto changeover unit shall be mounted on the panel are in the panel supplier's scope. Where DC control power supply is specified an additional 240V, 50 Hz AC supply feeder for powering of space heater and lighting shall be provided by the purchaser. Suitable arrangement shall be provided inside the panel to receive and terminate the power supply feeder(s). For this purpose MCBs of suitable current rating shall be provided by the vendor. A supervisory relay along with a pilot lamp to indicate control supply 'ON' shall be provided on the panel. Any other power supply required for the operation of the devices mounted in the panel shall be arranged by the vendor.

3.1.12 The internal wiring shall be carried out with 1100 volt grade PVC insulated copper multi strand wire / flexible of 1.5mm² size. AC & DC wires shall be kept separate from each other. Separate coloured wires to be used for AC and DC circuits. All wires shall be properly numbered and identified with ferrules as per the Control scheme / wiring diagram. Wires shall be routed and run through PVC troughs.

3.1.13 Terminal blocks shall be clip on type, 1100 volts grade. Separate terminal blocks shall be used for AC & DC circuits. The terminals shall be suitable for terminating 0.5 mm² to 2.5mm² external cables. The TB points in terminal block shall be cage clamp type / screw type. The terminal for ammeters shall be provided with removable links for shorting CTs. Each terminal strip shall be provided with identification strip. The terminal shall not be mounted below 250 mm height from finished floor. The panel shall have ten (20) percent spare terminal.

3.1.14 The interior of each panel shall be suitably illuminated through fluorescent lamps / tube lights with shrouded cover of minimum 15W operable on 240V 50 Hz AC power supply through panel door switch. A 15 Amp. 3-pin Power receptacle shall be provided.

3.1.15 Suitable space heaters operable on 240 Volts 50 Hz AC power system shall be provided at the panel bottom. These shall be designed to maintain the panel temperature five (5) deg. C above the ambient temperature during maintenance shutdown. Suitable isolating and control devices comprising of MCB, thermostat etc. shall be provided for the space heater.

3.1.16 The panel shall be provided with a copper earth bus of 25 x 6 mm size running throughout the width of the panel. It shall be terminated internally with 10 mm bolts at extreme ends for connection to; main station earth. The panel mounted equipments / devices shall be connected to earth bus through green coloured PVC insulated stranded copper conductor of 2.5 mm² size.

3.1.17 Local Panel shall be provided with main name plate of 150 mm x 40 mm size having inscription of 20 mm height. The individual devices on the panels shall be as provided with separate name plate with inscription of 3 mm height. The instrument / devices shall be provided with stick on label plates inside the panel. The material of the main and individual labels shall be three (3) ply 3 mm thick Traffolyte

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Sheet / 2 mm Anodised Aluminium Plate. The inscription shall be with white letters on black background on traffolyte sheet. The labels shall be fixed by self tapping non-rusting screws.

3.1.18 Vendor shall furnish electric load and heat load list (in case panel is to be placed in ac environment) of each panel.

3.2 Hazardous Area Panel Requirement

3.2.1 The Local Panel located in hazardous area shall be pressurized as per NFPA-496 requirements to render it non-hazardous. Alarms shall be provided for local and remote annunciation when pressurisation falls below 2.5 mm of water column. Protection shall be of type Z of NFPA-496. It shall not be possible to switch ON the power of purged section unless it is purged as per the recommendation of NFPA-496. Vendor must provide a protective device on the panel to protect the panel from over pressurisation.

3.2.2 Vendor shall supply pressurisation kit consisting of valves, restriction orifices, dual filter regulation, pressure gauges, pressure switches, rotameter etc. Pressurisation kit shall be surface mounting on a metal board and located outside the local panel. Pressurisation kit shall further consist of solenoid valve flow switch, timer blow off safety device etc., so as to make purging fully automatic. However final start shall be manual. Panel protection against over pressure to be provided as per NFPA-496.

3.2.3 Pressurised local control panel pressurization kit assembly design shall provide minimum leakage flow through the Local Control Panel. Panel venting shall be as per NFPA-496.

3.2.4 All components in the local panel like indicating instruments, push buttons switches, lamps etc., which are required to be energized without panel pressurization or before completion of purge cycle shall be explosion proof as per NEMA-7 & suitable for area classification.

3.2.5 All push buttons etc. requiring frequent operation during machine running shall have good positive sealing. Weatherproof housing or cover to be provided wherever necessary. Vendor shall provide pressurisation bypass switch outside explosion proof enclosure of pressurized panel with lamp indication. This shall be used only during maintenance. All hinges, screws, other non-painted metallic parts shall be of stainless steel material.

3.2.6 Provision to switch off manually all types of power shall be provided in the panel. In addition, it shall also be possible to switch off power circuits / components which are powered from motor control centre or control room manually in case of pressurization failure. All such cables from MCC and main control room shall be terminated in explosion proof boxes (NEMA-7).

3.3 Control & Monitoring devices

3.3.1 Instruments like Indicators, recorders, single loop controllers etc. as applicable and specified elsewhere for the plant / equipment shall be supplied and mounted on the panel.

3.3.2 Alarm Annunciator System

It shall be solid state discrete facia type having a sequence of ISA-S18.1A or as specified, opaque facia windows of 70 mm x 50 mm size, having two (2) lamps per window, and hooter of 10W, and provision for repeat group alarm at remote. The annunciator shall be provided with ten (10) percent spare windows or minimum two (2) windows along with electronics.

3.3.3 Relays

The relays shall be electromagnetic type suitable for specified control supply. Its contact configuration and rating shall be suitable for the specified control function. However minimum contact rating shall be 5 Amp AC & 2 Amp DC as applicable. There shall be ten (10) percent spare contacts.

3.3.4 Timers

The timers shall be electronic type suitable for specified control supply. Its contact configuration and rating shall be suitable for the specified control function. However, minimum contact rating shall be 5 Amp AC & 2 Amp DC as applicable.

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3.3.5 Control / Selector Switches
Switches shall be Rotary Cam type with minimum of 5 Amps AC & 2 Amp DC continuous current rating. Selector switches shall be stay put type while control switches shall be spring-return-to-neutral type. Contact configuration and rating shall be as per the control function requirement. The switches shall be lockable type wherever specified. Each switch shall be provided with engraved plates indicating the switch position / functions.

3.3.6 Push Buttons / Indicating Lights
The push buttons shall be momentary action self-resetting type, however stop P.B. for unidirectional drives shall be provided with manual reset facility. Its contact configuration & rating shall be as required for the control function but minimum 2 NO + 2 NC of 5 Amp. AC rating. It shall have round coloured projecting tab and engraved escutcheon plate / inscription plate. Colour coding of push buttons shall be as under:

RED	Motor OFF / Valve CLOSE	YELLOW	Alarm acknowledge	Left Hand Side
GREEN	Motor ON / Valve OPEN	BLACK	Lamp test	Right Hand Side

Indicating lights shall be suitable for direct connections across specified power supplies. It shall be fitted with built in resistance to prevent circuit tripping on shorting of lamp filament. It shall be fitted with LED cluster type lamp replaceable from front.

GREEN	Motor OFF / Valve CLOSED condition	AMBER	Motor tripped	Left Hand Side
RED	Motor ON / Valve OPEN condition	WHITE	Normal / healthy	Right Hand Side

3.3.7 Ammeters
Ammeter shall be 96 x 96 mm size, 90 deg. deflection, 1.5% accuracy, 1 Amp. CT operated or with 4-20mA input and Flush mounting type as called for in the data sheet-A (No. PES-145-54A-DS1-0). Ammeters for motors shall have six (6) times folded scale at upper end to enable motor starting current indication

3.3.8 Miniature Circuit Breaker (MCB)
These shall be instantaneous magnetic trip type for short circuit in addition to current time inverse delayed thermal trip feature for over current protection. The housing of MCB shall be made of non-ignitable, high impact material. It shall have minimum short circuit rating of 9 KA for AC Voltages and 4 KA for DC Voltages.

3.3.9 Makes of various instruments / devices shall be as given below

1.	Alarm Annunciators	:	Procon / IIC
2.	Ammeters	:	AEP / IMP
3.	Control / Selector Switches	:	Alsthom / Kaycee / Siemens / L&T
4.	Push Buttons / Indicating Lamps	:	Siemens / L&T / Teknic / Alsthom
5.	Auxiliary Relays	:	Jyoti / Siemens / L&T / OEN
6.	Timers	:	L&T / Alsthom / Bhartiya Cutler Hammer
7.	MCBs	:	S&S Power Engg. / Indo Asian / MDS
8.	Terminal Blocks	:	Jyoti / Elmex

4.0 TESTING AND INSPECTION

4.1 The bidder shall adopt suitable quality assurance program to ensure that the equipments offered will meet the specification requirements in full.

4.2 BHEL's standard Quality Plan for LCP is enclosed with the specification. The bidder shall furnish his acceptance to BHEL's QP and submit the signed and stamped copy of QP along with the offer.

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		SHEET 5	OF 6

4.3 The vendor shall conduct the following tests as a minimum requirement:

4.3.1 Routine Tests

1. High Voltage (H.V.)
2. Insulation Resistance (I.R.)
3. Functional

4.3.2 Type Tests

1. Enclosure Class Test

5.0 SPARES AND CONSUMABLES

5.1 Commissioning Spares and consumables

The bidder shall supply all commissioning spares and consumables 'as required' during Start-up, as part of the main equipment supply.

5.2. Mandatory Spares

The bidder shall offer alongwith main offer, the Mandatory Spares as specified elsewhere in the specification. The Mandatory Spares offered shall be of the same make and type as the main equipment.

5.3. Recommended Spares

The bidder shall furnish a list of Recommended Spares indicating the normal service expectancy period and frequency of replacement; quantities recommended for 3 years operation alongwith unit rate against each item to enable BHEL/BHEL's Customer to place a separate order later, if required.

6.0 DRAWINGS AND DOCUMENTS

6.1 The bidder shall furnish the following documents in required number of copies along with the bid :

1. Data Sheet no. PES-145A-DS1-0
2. General Arrangement Drawing.
3. Catalogue and technical information for instruments and devices.
4. Quality Plan.

6.2 The vendor shall furnish the following documents in required number as agreed after the award of contract:

1. Data Shee No. PES-145A-DS2-0
2. GA Drawing indicating layout of instruments, construction details, foundation details, cable gland plate alongwith cable glands and all details mentioned in this specification.
3. Control Schematic Diagram along with grouping of different terminals for various functions.
4. Catalogue and technical information for instruments and devices with selected options clearly marked.
5. O&M Manuals.
6. "As Built" Drawing.
7. CDs.

7.0 MARKING AND PACKING

7.1 Panel with all instruments / devices mounted on it shall be suitably packed & protected for the entire period of despatch, storage and erection against impact, abrasion, corrosion, incidental damage due

	SPECIFICATION FOR LOCAL PANELS	SPECIFICATION NO.: PE-SS –999- 145 –054A	
		VOLUME	II B
		SECTION	D
		REV. NO. 03	DATE : 16-09-2013
		SHEET	6 OF 6

to vermin, sunlight, high temperature, rain moisture, humidity, dust, sea-water spray (where applicable) as well as rough handling and delays in Transit and storage in open.

8.0 APPLICABLE DATA SHEET FORMS

This document shall be read with one or more of the following data sheet forms :

- Data sheet A&B for Local Panels : Data sheet no. PES-145A-DS1-0
- Data sheet C for Local Panels : Data sheet no. PES-145A-DS2-0

 PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL						STD QUALITY PLAN NO.: PE-QP-999-145-1056					
								VOLUME		IIB			
								SECTION		D			
								REV. NO.		01		DATE: 22-02-2008	
								SHEET		1		OF 7	
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks	
									P	W	V		
1.0	INCOMING Sheet Steel (CRCA & HR)	1. Chemical Composition	MA	Chemical analysis	Sample	IS:1079 IS:513	IS:1079 IS:513	Test Certificate	3	---	2		
		2. Bend Test	CR	Mech. test	Sample	IS:1079 IS:513	IS:1079 IS:513	Log Book	2	---	---		
		3. Surface finish	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---		
		4. Waviness	MA	Visual	100%	Factory Standard	No Waviness	Log Book	2	---	---		
		5. Thickness	MA	Measurement	100%	BHEL Spec.	BHEL Spec.	Log Book	2	---	---		
		6. Mill marking	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	1		
2.0	Flats / Angles / Channels	1. Dimensions	MA	Measurement	Sample	IS:2062	IS:2062	Log Book	2	---	---		
		2. Surface Defects	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---		
		3. Straightness	MA	Measurement	100%	Factory Std.	Factory Std.	Log Book	2	---	---		
		4. Mill marking	MA	Visual	100%	IS:2062	IS:2062	Log Book	2	---	1		
3.0	Cables / Wires	1. Visual / Surface defects	MA	Visual	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---		
		2. IR and HV	MA	Electrical	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---		
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics ^s P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test. 1 - BHEL 2 - Vendor 3 - Sub-vendor													

 PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL						STD QUALITY PLAN NO.: PE-QP-999-145-I056				
								VOLUME IIB				
								SECTION D				
								REV. NO. 01 DATE: 22-02-2008				
								SHEET 2 OF 7				
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
		3. Conductor a) Resistance b) Size c) Sheet colour	MA MA MA	Electrical Measurement Visual	100% 100% 100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
		4. Type / Routine Test Certificates	MA	Verification	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	3	---	2	
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays Timers Space Heaters Thermostat Indicating meters etc.	1. Verification at make and Type 2. Verification of Test Certificates 3. Operation / Functional check 4. I.R. 5. H.V. 6. Calibration 7. Pick up / Drop off Voltage	CR CR CR MA MA MA MA	Visual Scrutiny of Type / Routine T.Cs. Electrical Electrical Electrical Electrical	Sample 100% Sample+ 100% 100% 100% 100% 100%	BHEL Spec. and BOM Relevant IS Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue	BHEL Spec. and BOM Relevant IS Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue	Log Book Log Book Log Book Log Book Log Book Log Book Log Book	2 2 2 2 2 2 2	--- --- --- --- --- --- ---	--- --- --- --- --- 1 ---	+ for relay & contactors only @ for all components except relays & contactors.
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics ^s P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test. 1 - BHEL 2 - Vendor 3 - Sub-vendor												

 PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL						STD QUALITY PLAN NO.: PE-QP-999-145-1056					
								VOLUME		IIB			
								SECTION		D			
								REV. NO.		01		DATE: 22-02-2008	
								SHEET		3		OF 7	
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks	
									P	W	V		
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---		
		2. Surface defects	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---		
		3. IR / HV on Terminal Blocks	MA	Electrical	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---		
6.0	IN PROCESS Blanking / Bending / Forming	1. Dimensions	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---		
		2. Surface defects after bending	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	---		
7.0	Nibbling / Punching	1. Cutout Sizes	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---		
		2. Deburring	MA	Visual	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---		
8.0	ASSEMBLY Frame Assembly & Sheet fixing	1. Dimensions	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2		
		2. Alignment	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2		
		3. Welding Quality	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2		
		4. Surface defects	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2		
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						^s P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.			1 - BHEL 2 - Vendor 3 - Sub-vendor				

बीएल PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL						STD QUALITY PLAN NO.: PE-QP-999-145-1056					
								VOLUME		IIB			
								SECTION		D			
								REV. NO.		01		DATE: 22-02-2008	
								SHEET		4		OF 7	
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks	
									P	W	V		
9.0	Pre-treatment and Painting	1. Pretreatment Process	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1		
		2. Process parameters like bath temp. concentration etc.	MA	Measurement	Periodic	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1		
		3. Dipping / Removal Time	MA	Measurement	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1		
		4. Surface quality after every dip	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1		
		5. Primer after phosphating	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1		
		6. Putty Application & Rubbing after primer	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1		
		7. Paint first coat	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1		
		8. Putty Application and Rubbing after first coat of paint	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1		
		9. Paint second coat	MA	Visual, Thickness, Scratch test Colour adhesion	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1		
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 PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL							STD QUALITY PLAN NO.: PE-QP-999-145-I056			
									VOLUME IIB			
									SECTION D			
									REV. NO. 01		DATE: 22-02-2008	
									SHEET 5		OF 7	
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
10.	Panel Wiring	1. Wiring Layout	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		2. Wiring Termination (Crimped Lugs)	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		3. Ferrule numbers	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		4. Colour of wiring	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
		5. Size of Conductor	MA	Measurement	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
11.	Component Mounting	1. Correct components	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
		2. Fixing	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
12.	FINAL Final Inspection	1. Workmanship	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.
		2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		3. Components identification Marking / Name plates	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	

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बी एच ई एल BHEL PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL						STD QUALITY PLAN NO.: PE-QP-999-145-I056					
								VOLUME		IIB			
								SECTION		D			
								REV. NO.		01		DATE: 22-02-2008	
								SHEET		6		OF 7	
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks	
									P	W	V		
		5. Dimensions	MA	Measurement	100%	BHEL approved drg. / Spec., BOM	BHEL approved drg. / Spec., BOM	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.	
		6. Door functioning	MA	Functional	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1		
		7. Paint Shade	CR	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1		
		8. Paint Thickness	CR	Measurement	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1		
		9. Workmanship of Gaskets	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1		
		10. Wiring Layout	MA	Visual	100%	BHEL approved drg.	BHEL approved drg.	Inspection Report	2	1	1		
		11. Wire Termination	MA	Pulling manually	Sample	-----	Firm termination	Inspection Report	2	1	1		
		12. Continuity	MA	Electrical	100%	-----	Continuity OK	Inspection Report	2	1	1		

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 PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL						STD QUALITY PLAN NO.: PE-QP-999-145-I056				
								VOLUME IIB				
								SECTION D				
								REV. NO. 01 DATE: 22-02-2008				
								SHEET 7 OF 7				
Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
13.	TYPE TEST	Degree of Protection	CR	Mech. Protection	Sample	BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148.	BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148.	Type Test Certificate	3	---	1	
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	BHEL approved spec., drg., BOM & relevant IS.	BHEL approved spec., drg., BOM & relevant IS.	Test Report	2	1	1	
15	FUCTIONAL TEST	1. Control Logic Operation	CR	Electrical	100%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1	
		2. Instrument Calibratio	CR	Electrical	10%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1	
		3. Temperature rise	CR	Electrical	100%	BHEL approved spec/drg. & relevant IS.	BHEL approved spec/drg & relevant IS.	Inspection Report	2	1	1	

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 W - Agency Witnessing the Test.
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1 - BHEL
 2 - Vendor
 3 - Sub-vendor

FORM NO. PEM-6666-0

	DATA SHEET FOR LOCAL PANELS		SPECIFICATION NO.: PES-145-054A	
			VOLUME	
			SECTION	
			REV. NO. 01	DATE: 24.01.2019
			SHEET 1	OF 2
TAG No. Qty.....			Data Sheet No.: PES-145A-DS1-0	
Data Sheet A & B				
DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
GENERAL	MANUFACTURER			
	CONSTRUCTION		☐ FOLDED ☐ WELDED (As per requirement EDN)	
	ENCLOSURE SHEET THICKNESS	FRONT	☒ 3.0 mm (FOR FACES SUPPORTING INSTRUMENTS/TERMINALS)	
		OTHER	☒ 2.0 mm (FOR OTHER SIDES AND TOP)	
		DOOR	☒ 2.0 mm	
		HEIGHT	☐ 2365 mm for stand alone panels. (THIS SHALL BE DECIDED BY BHEL DURING DETAILED ENGG.)	
		OTHER	☐	
TECHNICAL	INPUT POWER SUPPLY *		☐ 240V 50 Hz AC ☐ 220V DC ☐ 415V 3 PHASE 3W ☐ 415V 3 PHASE 4W	
	NO. OF FEEDERS		☐ ONE ☒ TWO	
	CONTROL SUPPLY		☐ 110V AC ☐ 220V AC ☐ 220V DC ☐ Other. (As per requirement)	
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)		_____ NOS. (AS REQUIRED)	
	PAINT TYPE		☐ EPOXY ENAMEL ☒ EPOXY POWDER COATED OR BETTER (THIS SHALL BE DECIDED BY BHEL DURING DETAILED ENGG.)	
	PANEL COLOUR (EXTERNAL)		☐ LIGHT GREY (Shade 631 IS-5) ☐ OPALINE GREEN (Shade 275) . ☒ RAL 7032 (THIS SHALL BE DECIDED BY BHEL DURING DETAILED ENGG.)	
	FINISH (EXTERNAL)		☐ MATT ☐ GLOSSY ☐ SEMI GLOSSY	
	PANEL COLOUR (INTERNAL)		☐ WHITE ☐ CREAM ☐ OFF WHITE ☒ BRILLIANT WHITE	
	FINISH (INTERNAL)		☐ MATT ☐ GLOSSY ☐ SEMI GLOSSY	
	CLASS OF PROTECTION		☐ IP-42 (FOR INDOOR SERVICE) ☒ IP-55 (FOR OUTDOOR SERVICE) ☐ ANY OTHER	
	CONTROL HARDWARE		☒ RELAY BASED	
	FOUNDATION ARRANGEMENT		☐ FOUNDATION BOLTS ☐ ANCHOR FASTENERS	
	WEIGHT OF PANEL (Kg.)			
	PANEL TYPE		☐ PRESSURISED ☐ UNPRESSURISED As per Requirement	
	CABLE GLAND		☐ DOUBLE COMPRESSION	
	AMMETER (TYPE OF INPUT) *		☐ 1 Amp CT ☐ 4-20 mA	

FORM NO. PEM-6666-0

	DATA SHEET FOR LOCAL PANELS			SPECIFICATION NO.: PES-145-054A	
				VOLUME	
				SECTION	
				REV. NO. 01	DATE: 24.01.2019
				SHEET 2	OF 2
TAG No. Qty.....			Data Sheet No.: PES-145A-DS1-0		
Data Sheet A & B					
DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)				DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
* TO BE CO-ORDINATED WITH PEM ELECTRICAL					
NAME SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL NAME: SIGNATURE: DATE:	

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	

DRIVE CONTROL PHILOSOPHY

	MAHARASHTRA STATE POWER GENERATION CO. LTD.		Volume: V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1		Section – 1
REV: R0	CONTROL & INSTRUMENTATION		Page 30 of 718
SR. NO.	DESCRIPTION	TYPE OF I/O	NO. OF I/O
	(v) Close limit switch feedback	DI	1 COC
	(vi) Position Transmitter (For inching type Drive)	AI	1
(d)	DCS/PLC INTERFACE FOR BIDIRECTIONAL LT DRIVE-For Non-Integral starters (Signal Exchange has been envisaged between Actuator and DCS/PLC.)		
	(i) Open Command	DO	1
	(ii) Close Command	DO	1
	(iii) Swgr/MCC Disturbance (Overload relay operated/ control supply fail/ Emergency LPBS stop)	DI	1
	(iv) Switchgear/MCC Available (switchgear/MCC in remote)	DI	1
	(v) Open limit switch feedback	DI	1 COC
	(vi) Close limit switch feedback	DI	1 COC
	(vii) Position Transmitter (For inching type Drive)	AI	1
(e)	DCS/PLC INTERFACE FOR SOLENOID DRIVE (Single coil)		
	(i) Energies or De-Energies	DO	1
	(ii) Open limit switch feedback	DI	1 COC
	(iii) Close limit switch feedback	DI	1 COC

CONSULTANT : PROCON ENGINEERS

	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – I
REV: R0	CONTROL & INSTRUMENTATION	Page 31 of 718

SR. NO.	DESCRIPTION	TYPE OF I/O	NO. OF I/O
(f)	DCS/PLC INTERFACE FOR SOLENOID DRIVE (Double coil)		
	(i) Energize	DO	1
	(ii) De-Energize	DO	1
	(iii) Open limit switch feedback	DI	1 COC
	(iv) Close limit switch feedback	DI	1 COC
(g)	DCS/PLC INTERFACE FOR PNEUMATIC DRIVE		
	(i) Command to I/P converter	AO	1
	(ii) Position Transmitter	AI	1
	(iii) Open limit switch feedback	DI	1 COC
	(iv) Close limit switch feedback	DI	1 COC
	(v) Command to Solenoid valve (Wherever applicable)	DO	1

Above I/Os used in OLCS or CLCS loops shall be redundant.

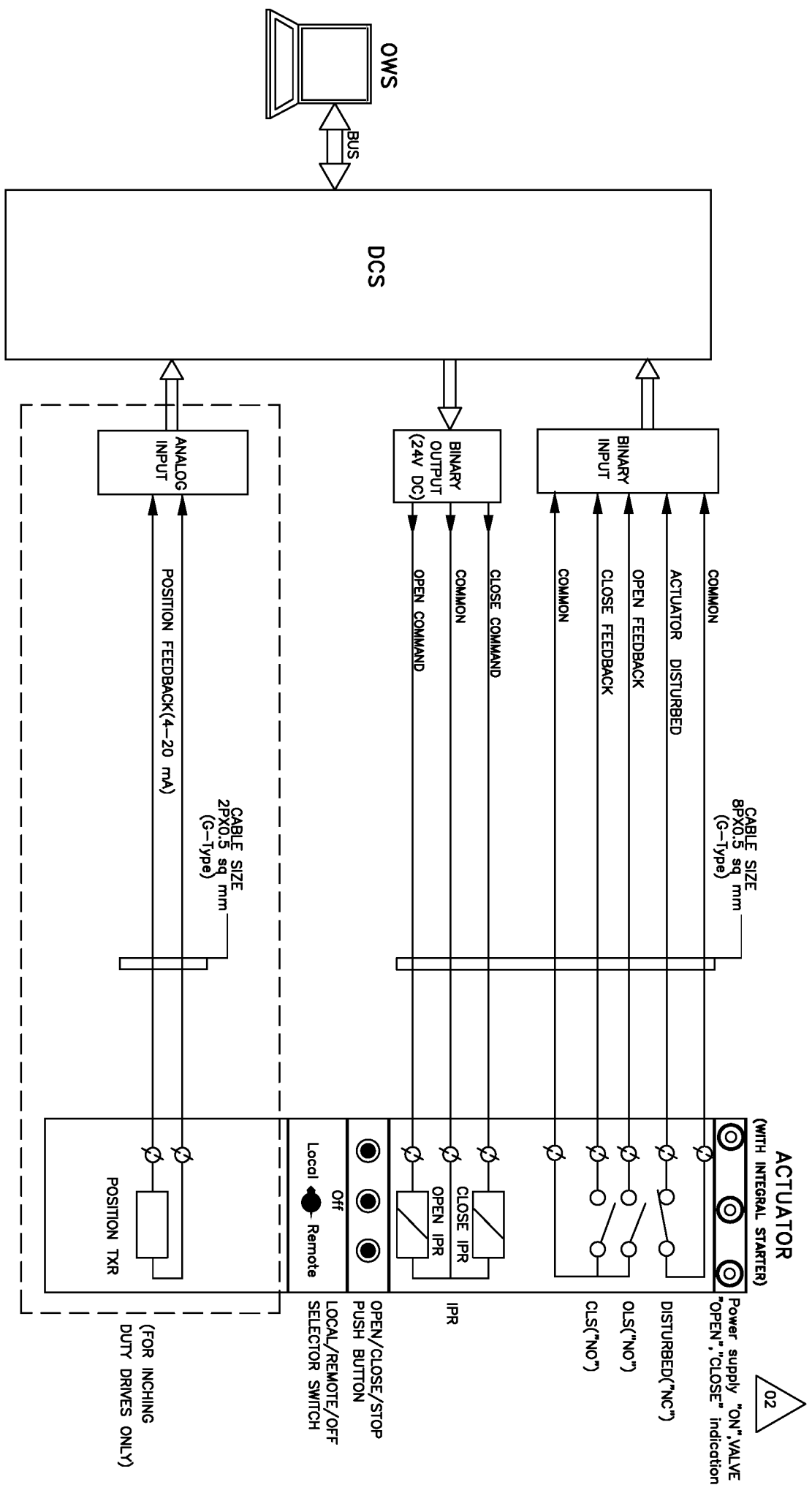
4.35 ELECTRICAL DISTRIBUTION AND MANAGEMENT SYSTEM

The entire unit and station electrical system within powerhouse area shall be monitored and operated from DCS and off-site-plant electrical system shall be monitored & operated from respective PLCs.

Plant Electrical Distribution system i.e. Unit Bus, Station Bus, Incoming & Outgoing feeders, transformer feeders, bus-couplers etc. shall be operated and monitored from DCS. Trip and interlocking functions shall be hardwired at equipment level.

CONSULTANT : PROCON ENGINEERS

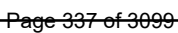
DCS INTERFACE FOR BIDIRECTIONAL DRIVE(WITH INTEGRAL STARTER)



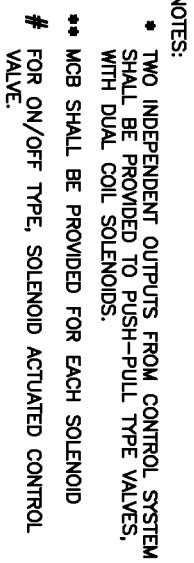
NOTE:

1. DISTURBED= Loss of Power supply (1 Phase/3 Phase),
Loss of control supply, Motor thermostat trip,
Thermal over load relay trip, Valve jammed,
Torque open/close cut off, Local/Off/Remote Sel. switch
in local or off mode etc.

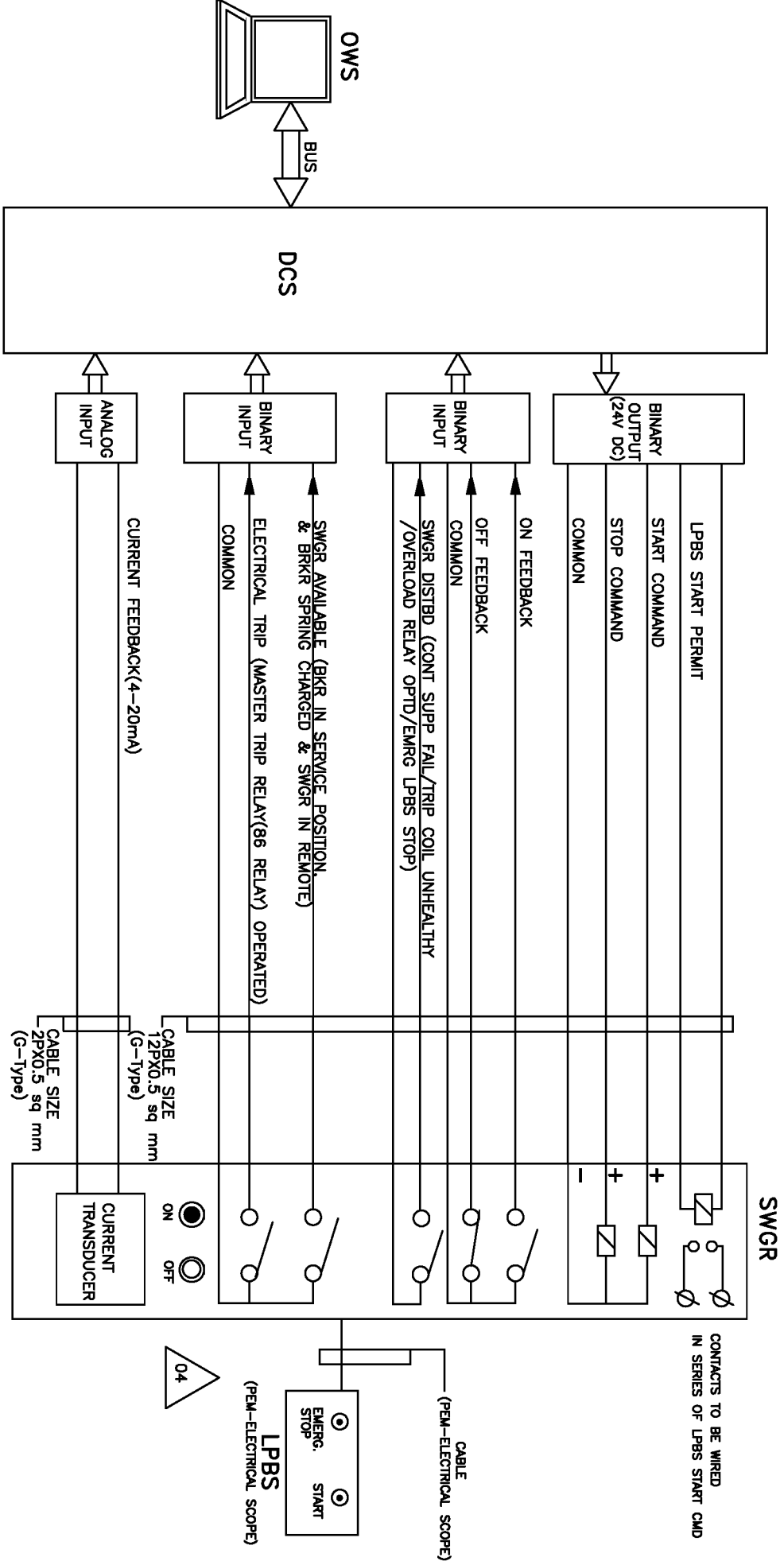
PROJECT: 1x660 MW BHUSAWAL STPP		DRG.NO.	PE-DM-415-145-1002		
TITLE		DATE	01.10.2018		
DDCMS INTERFACE FOR BIDIRECTIONAL DRIVE		REV.NO.	04		
		SHT	8	OF	12



PROJECT:		1x660 MW BHUSAWAL STPP	
DRG. NO.		PE-DW-415-145-1002	
DATE		01.10.2018	
TITLE		DDCMIS INTERFACE FOR UNIDIRECTIONAL LT DRIVE	
REV. NO.	04		
SHT	9	OF	12

~~Page 338 of 3099~~

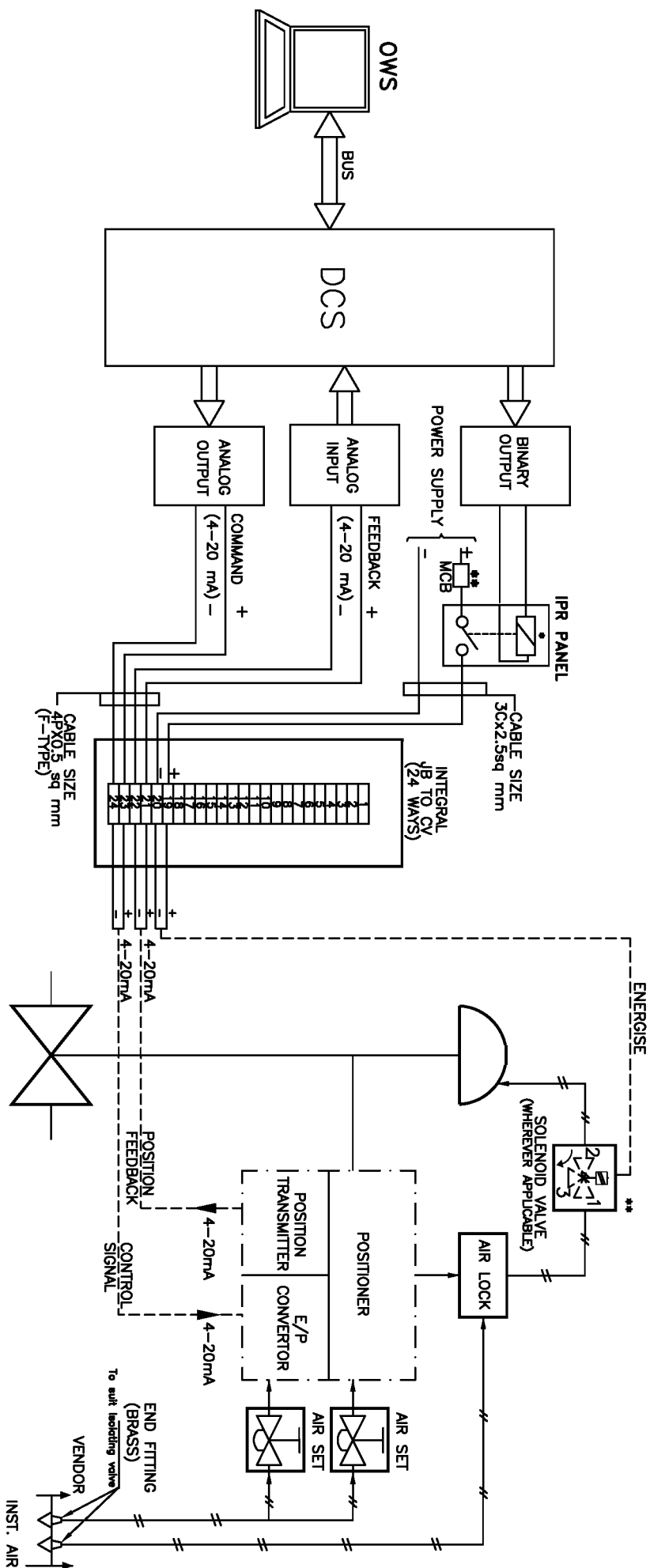
DCS INTERFACE FOR HT/LT UNIDIRECTIONAL DRIVES(BREAKER OPERATED)



NOTE:- INTERPOSING RELAYS(IPRs) TO BE SUPPLIED ALONG WITH SWITCHGEAR.
BEARING AND WINDING TEMPERATURES FOR HT DRIVES SHALL BE HOOKED TO DCS.



PROJECT:	1x660 MW BHUSAWAL STPP	DRG.NO.	PE-DM-415-145-1002
TITLE	DDCMS INTERFACE FOR UNIDIRECTIONAL HT DRIVE	DATE	01.10.2018
		REV.NO.	04
		SHT	11 OF 12



**** APPLICABLE TO VALVES WHERE PROTECTION OPEN/CLOSE ACTION FOR CONTROL DEMAND OVERRIDING IS REQUIRED.**

 DRG. NO.			
PROJECT:		1x660 MW BHUSAWAL STPP	
TITLE		TYPICAL HOOK-UP DIAGRAM ANALOG DRIVE	
		DRG. NO.	PE-DM-415-145-1002
		DATE	01.10.2018
		REV. NO.	04
		SHT	12 OF 12

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	

APPLICABLE CODES AND STANDARDS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 1
REV: R0	CONTROL & INSTRUMENTATION	Page 37 of 718
The required quantities of cable accessories shall be similarly estimated on the basis of number of terminations and proposed routing of the cables and shall be included in the offer allowing a positive allowance of at least 30% for each accessory. The exact quantity of different accessories shall be specified in the offer. Any shortfall in the quantity of accessories observed during actual laying shall be compensated at no extra cost. 5.0 <u>PROVEN PRODUCT</u> 5.1 The offered model of DCS, Microprocessor based control system must have been successfully supplied, erected, tested and commissioned as complete station Control & Instrumentation system for at least two units of capacity not less than 600 MW supercritical Thermal Power Station(s) with reheat type pulverized coal fired boiler. Further, these units should be in successful operation for a minimum period of two (2) years. 5.2 Similarly, all other C&I equipment/PLC/systems/sub-systems/instruments and accessories in the power cycle shall also be of make and model whose guaranteed and trouble-free performance has been proven at least for two (2) years in not less than two (2) different reheat type pulverized coal fired units of unit size not less than 500 MW. 5.3 Bidder shall furnish required information to fully satisfy Owner regarding successful operation and high reliability of products/systems furnished. 6.0 <u>CODES AND STANDARDS</u> 6.1 Items such as thermowells, control valves, flow elements and other in line devices in high and medium pressure steam, feed water and similar services, which fall under the purview of Indian Boiler Regulation Act shall be either certified by IBR or shall be certified by authorities acceptable to IBR. It shall be responsibility of Bidder to obtain the necessary approval of the concerned Authority/Chief Inspector of Boiler for the design and design calculations, manufacturing and erection procedure as called for under the IBR Act for all items requiring such certification. 6.2 Generally, the following latest edition of codes and standards prevailing at the time of award of contract shall be applicable.		

CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 1
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6.2.1 Temperature Measurement (a) Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974). (b) Temperature Measurement - Thermocouples - ANSI - MC 96.1 - 1982. (c) Temperature Measurement by electrical resistance thermometers - IS: 2806. (d) Thermometer-element-Platinum resistance - IS: 2848 / DIN 43760. 6.2.2 Pressure Measurement (a) Instrument and apparatus for pressure measurement - ASME PTC 19.2 (1964). (b) Bourdon tube pressure and vacuum gauges - IS: 3624/1996. 6.2.3 Flow Measurement (a) Instruments and apparatus for flow measurement - ASME PTC 19.5 (1972) Interim supplement, Part-II. (b) Measurements of fluid flow in closed conduit - BS 1042. 6.2.4 Electronic Measuring Instruments and Control Hardware (a) Automatic null balancing electrical measuring instruments -ANSI C 39.4 (Rev. 1973), IS 9319. (b) Safety requirements for electrical and electronic measuring and controlling instrumentation - ANSI C 39.5/1974. (c) Compatibility of analog signals for electronic industrial process instruments - ISA-S 50.1: ANSI MC 12.1/1975. (d) Dynamic response testing of process control instrumentation - ANSI MC 4.1 (1975) - ISA -S26 (1968).		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 1
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	(e) Surge withstand capability (SWC) tests - ANSI C 37.90A (1989), IEC-255.4. (f) Printed circuit boards - IPC TM-650, IEC 326C. (g) General requirements and tests for printed wiring boards - IS-7405 (Part-I)/1973. (h) Edge socket connectors - IEC 130-11. (i) Requirements and methods of testing of wire wrap terminations- DIN 41611 Part-2. (j) Dimensions of attachment plugs and receptacles- ANSI C73-1973. (Supplement ANSI C73a – 1980. 6.2.5 Instrument Switches and Contacts (a) Contact Rating - AC services NEMA ICS Part-2 125, A-600. (b) Contact Rating - DC services NEMA ICS Part-2 125, N-600. 6.2.6 Enclosures (a) Enclosures for Industrial Controls and Systems–NEMA ICS-6-110.15 through 110.22. (b) Racks, panels and associated equipment -EIA: RS-310-B-1983 (ANSI C83.9 - 1972). 6.2.7 Apparatus, Enclosures and Installation Practices in Hazardous Area (a) Classification of hazardous area - NEMA Article 500, Volume-6, 1978. (b) Electrical Instruments in hazardous dust locations - ISA-RP 12.11. (c) Intrinsically safe apparatus - NFPA Article 493 Volume-4 1978.	

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 MAHARASHTRA STATE POWER GENERATION CO. LTD.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – I
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(d) Purged and pressurized enclosure for electrical equipment in hazardous location - NFPA Article 496 Volume-4, 1978. 6.2.8 Sampling System (a) Stainless Steel material of tubing and valves, for sampling system - ASTM A 269-79 GRTO-316. (b) Submerged helical coil heat exchangers for sample coolers - ASTM D11-98. 6.2.9 Annunciator (a) Specifications and guides for the use of general-purpose annunciators - ISA RP 18.1. (b) Surge withstand capability tests -ANSI C37.90 a -1971 and IEEE Standard 472-1974. 6.2.10 Interlocks, Protections (a) Relays and relay system associated with electric power apparatus - IEEE Standards 3.13. (b) Surge withstand capability tests - ANSI C37.90 a - 1971 and IEEE Standard 472-1974. (c) General requirements and tests for switching devices for control and auxiliary circuits including contactor relays - IS-6875 (Part-I)/ 1973. (d) Turbine water damage prevention - ASME-TDP-1-1980. (e) Boiler safety interlocks - NFPA Section 85B, 85D, 85E, 85F, 85G. 6.2.11 UPS System (a) Practice and requirements for semi-conductor power rectifiers - ANSI C34.2.		

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V
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	(b) Relays and relay systems associated with electrical power apparatus IEEE Standard - 3.13. (c) Surge withstand capability tests - ANSI C 70.90 A/1971, IEC-255.4. (d) Recommended practice for sizing large lead storage batteries for generating stations and sub-stations - -IEEE-485. (e) Battery: IEEE Std. 1106/IS, 10918, BS 6920-II: 1984, IS 1652, IEC 896-1987. (f) For Lead acid plante type battery selection & sizing : IEEE Std. 485:1997	
6.2.12	Control Valves (a) Control valve sizing (Incompressible fluids) - ISA-S39.2 / 1972. (b) Control valve sizing (Compressible fluids) - ISA-S39.4 / 1972. (c) Control Valve seat leakage – ANSI / FCI 70.2. (d) Face to face dimensions of Control Valves - ANSI B16.10. (e) Control Valve Capacity Test Procedure – ISA – S75.02.	
6.2.13	Instrument Tubing (a) Seamless Carbon Steel Pipe - ASTM-A-106. (b) Forged carbon steel fittings - ASTM-A-105. (c) Dimensions of fittings - ANSI-B16.11. (d) Code for pressure piping, welding, hydrostatic testing - ANSI-B 31.1. (e) Nomenclature for instrument tube fittings - ISA-RP 42.1 / 1982. (f) Seamless Stainless Steel Tube ASTM A-213 TP 316 / ASTM A-269 TP 316.	

CONSULTANT : PROCON ENGINEERS

 MAHARASHTRA STATE POWER GENERATION CO. LTD.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: V
	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – 1
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(g) Seamless Alloy Steel Pipe ASTM A 335 P22. (h) Seamless Stainless Steel Pipe ASTM A-312 TP 316. 6.2.14 Cables (a) Thermocouple extension wires/cables - ANSI MC96.1. (b) Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy-IPCEA S-61-402. (c) Guide for design and installation of cable system in power generating station (insulation, jacket materials) -IEEE Standard 422. (d) Requirements of vertical tray flame test - IEEE 383. (e) Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B33. 6.2.15 Electronic Cards, Subassemblies and Components (a) Unpackaged. (i) Vibration : IEC-68.2.6 (ii) Shock : IEC-68.2.27 (iii) Drop & Topple : IEC-68.2.31 (b) Packaged Vibration, Drop & Static Compression – NSTA. (c) Electromagnetic Compatibility (i) Electrical Fast Transient : IEC-801.4 (ii) Surge Withstand : IEC-255.4		

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	BID SPECIFICATION NO.:DG/BSL U-6/2011/T-1	Section – I
REV: R0	CONTROL & INSTRUMENTATION	Page 43 of 718
	(iii) Radiated Electromagnetic Field : IEC-801.3 (iv) Electrostatic Discharge : IEC-801.2 (v) Electromagnetic Emissions : VDE 0871, Class-B	
6.2.16	Cable Trays, Conduits (a) Guide for the design and installation of cable system in power generating station (cable trays, support systems, conduits)- IEEE Standard 422, NEMA VE-1, NEC-1981. Test Standards NEMA VE-1-1979. (b) Galvanizing of carbon steel cable trays - ASTM A-386.	
7.0	<u>DESIGN CRITERIA</u> This section lays down the general design criteria to be adapted in designing the instrumentation and control system of the plant.	
7.1	<u>GENERAL REQUIREMENTS</u>	
7.1.1	Instrumentation, control and automation devices and accessories shall be designed with the following considerations: (a) Stable in spite of temperature fluctuations. (b) Able to withstand high humidity. (c) Weather proof. (d) Dust proof. (e) Corrosion resistant. (f) Erosion resistant. (g) Able to withstand high vibration.	

CONSULTANT : PROCON ENGINEERS

	1X660 MW Bhusawal STPP	SECTION: C SUB SECTION : C&I
	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
DRAWINGS		

G.A. DRAWING – TRANSMITTER RACK

FOR BID PURPOSE ONLY

ISSUE	BY	CH	DATE

PROCON ENGINEERS
(DIVISION OF NIMOTO CONSULTING ENGINEERS PVT. LTD.)

CLIENT : MAHARASHTRA STATE POWER GENERATION CO.LTD.

PROJECT : BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

DO NOT SCALE

DATE : 23-08-2011

G.A. DRAWING-TRANSMITTER RACK

SCALE ~

APPROVED

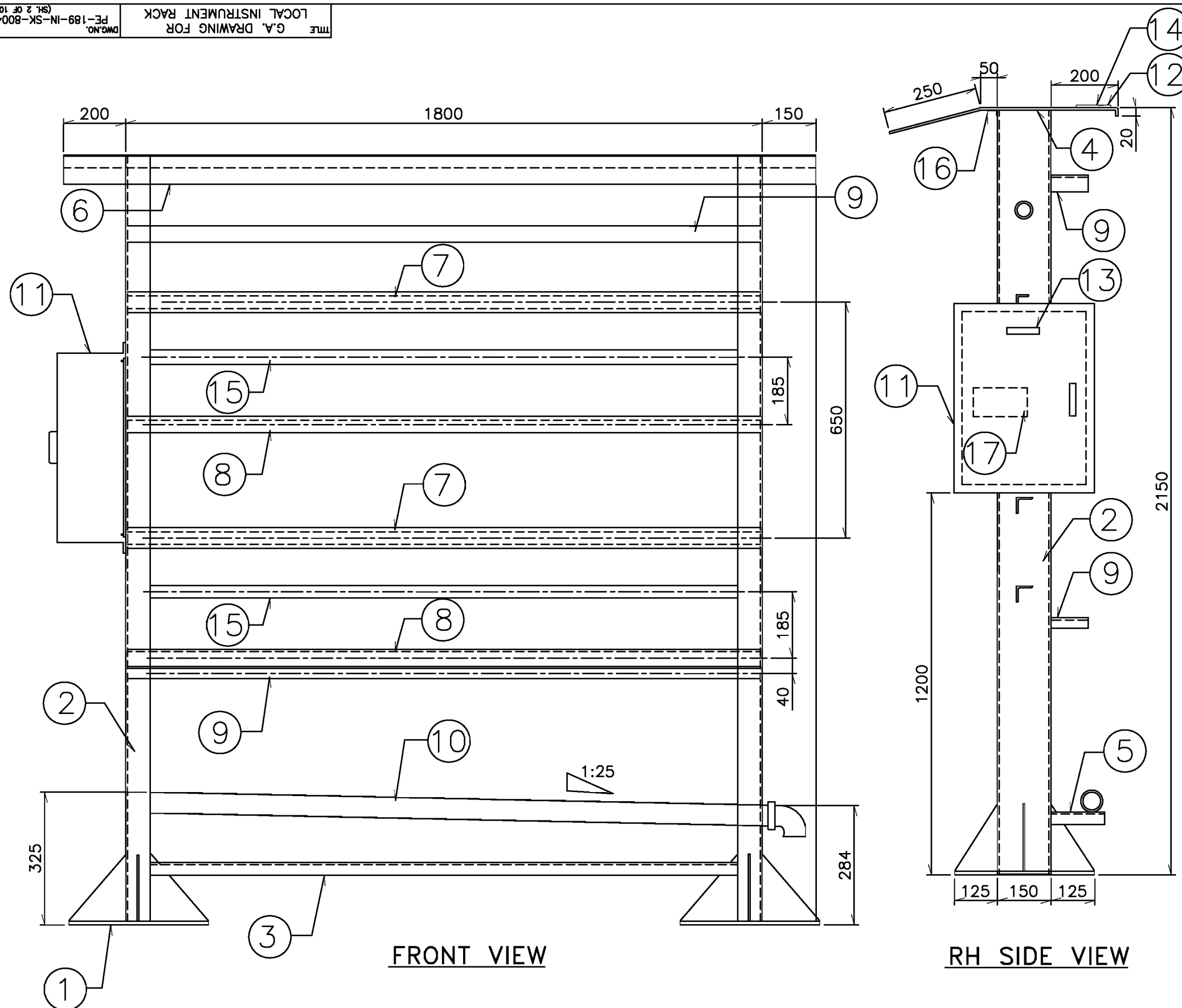
DIV INST.

DR P.N.Z.

CH D.J.P.

DWG.NO.PE-189-IN-SK-8004 (Sht. 1 of 10) PO

PE-189-IN-SK-8004 (SH. 2 OF 10)
 DWG. NO. LOCAL INSTRUMENT RACK
 G.A. DRAWING FOR

**LEGEND:**

ITEM NO.	DESCRIPTION
1.	M.S. PLATE 400 x 400 x 10
2.	ISMC 150 x 75 x 6
3.	ISMC 75 x 40 x 5
4.	CANOPY MOUNTING PLATE 5mm THICK.
5.	BRACKET FOR DRAIN PIPE.
6.	CANOPY ASSEMBLY 3.0mm THICK CRCA SHEET.
7.	GI PIPE 2" NB CLASS B FOR TRANSMITTER MOUNTING.
8.	M.S. ANGLE 40 x 40 x 5
9.	BRACKET FOR IMPULSE PIPE SUPPORT.
10.	DRAIN PIPE MATERIAL ASTM A106 GR. 'C' SIZE 2" NB SCH 80.
11.	JUNCTION BOX SIZE: 480(H) x 360(W) x 180(D).
12.	BULKHEAD M.S. PLATE 5mm THICK.
13.	COMPACT FLUORESCENT LAMP FOR RACK ILLUMINATION.
14.	XLPE GASKET IN BETWEEN BULKHEAD PLATE & CANOPY MOUNTING PLATE.
15.	PVC CABLE TRAY/ FLEXIBLE CONDUIT FOR CABLE
16.	C' CHANNEL FOR LIGHT FITTING.
17.	TAG PLATE.

NOTES:

1. POWER SOCKET & TB SHALL BE PROVIDED IN JB.
2. COLOR: RAL 7032. OVERALL THICKNESS > 100 MICRONS.
3. TAG PLATE SHALL BE PROVIDED FOR EACH INSTRUMENT.
4. 20% TERMINALS SHALL BE PROVIDED AS SPARE.
5. ANTIVIBRATION PAD & FOUNDATION BOLTS SHALL BE PROVIDED.
6. DIMENSIONS SHOWN ARE TENTATIVE AND SHALL BE FINALIZED AT DETAILING.
7. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.

FOR BID PURPOSE ONLY

DO NOT SCALE

ISSUE	REVISIONS	BY	CLEARED					APPD	DATE	FOR RO ISSUE ONLY			P (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION / FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK. CONSTRUCTION / FABRICATION WORK IS PERMITTED ON 'R' (RELEASED) ISSUES ONLY. INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION / FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR 'HOLD' IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION / FABRICATION WORK RELATED TO 'HOLD'.
			CHEM	CIVIL	ELEC	I&C	MECH			DEPT	SIGNATURE	DATE	



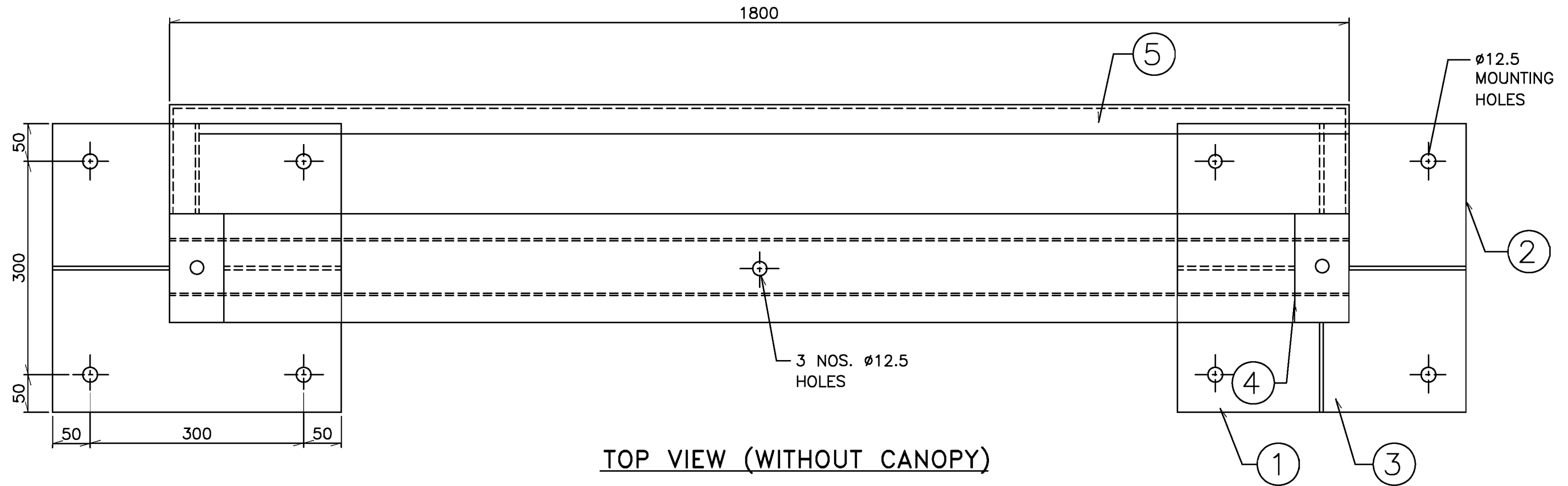
MAHARASHTRA STATE POWER GENERATION CO.LTD.
 BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

G.A. DRAWING FOR
 LOCAL INSTRUMENT RACK

PROCON ENGINEERS
 (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)

SCALE ~	APPROVED	DATE(RO ISSUE)
DIV. INST.		DATE(CURRENT ISSUE)
DR. P.N.Z.		23-08-2011
CH. D.J.P.	DWG. NO. PE-189-IN-SK-8004(SH. 2 OF 10)	ISSUE PO

VIEW OF LOCAL
INSTRUMENT RACK W/O CANOPY
DWG.NO. PE-189-IN-SK-8004
(SH. 3 OF 10)



TOP VIEW (WITHOUT CANOPY)

NOTES:

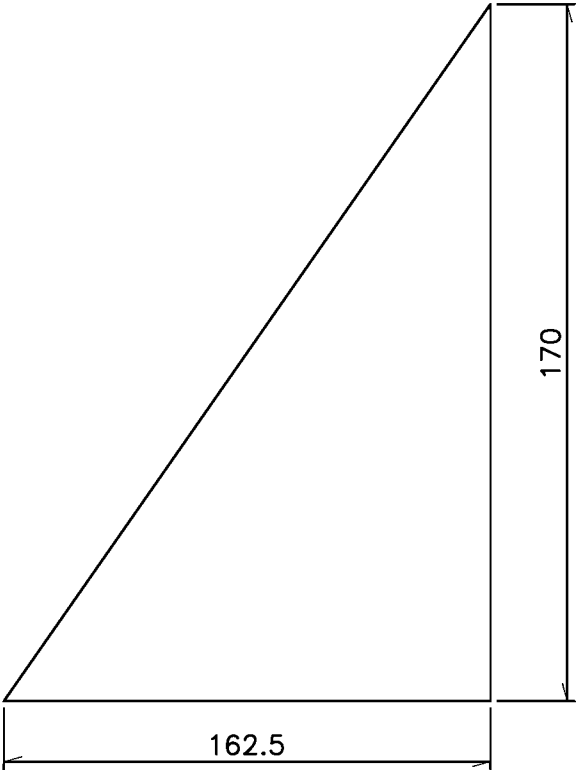
1. M.S. PLATE 400 x 400 x 10.
2. RIB M.S. PLATE 162.5 x 170 x 5 THICK.
3. RIB M.S. PLATE 125 x 170 x 5 THICK.
4. RIB M.S. PLATE 134 x 165 x 5 THICK.
(CANOPY MOUNTING PLATE SUPPORT)
5. BRACKET FOR IMPULSE PIPE SUPPORT.
6. ALL DIMENSIONS ARE IN mm
UNLESS OTHERWISE SPECIFIED.

FOR BID PURPOSE ONLY

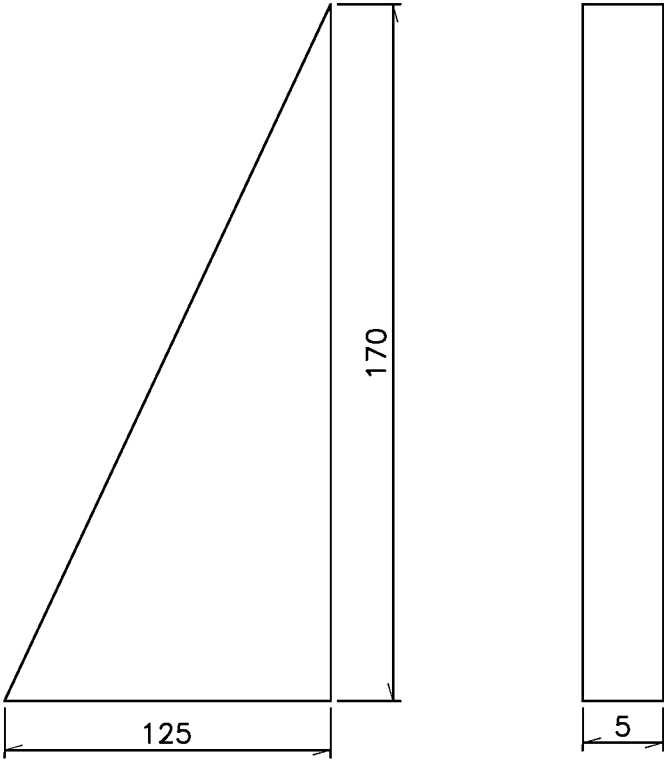
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ISSUE	REVISIONS	BY	CLEARED					APPD	DATE	FOR R0 ISSUE ONLY			"P" (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION / FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK. CONSTRUCTION / FABRICATION WORK IS PERMITTED ON "R" (RELEASED) ISSUES ONLY. INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION / FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR 'HOLD' IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION / FABRICATION WORK RELATED TO 'HOLD'.	MAHARASHTRA STATE POWER GENERATION CO.LTD. BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT VIEW OF LOCAL INSTRUMENT RACK W/O CANOPY	PROCON ENGINEERS (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)		
			CHEM	CIVIL	ELEC	I&C	MECH			DEPT	SIGNATURE	DATE			SCALE ~	APPROVED	DATE(R0 ISSUE)
										CHEM					DIV. INST.		DATE(CURRENT ISSUE)
										CIVIL					DR. P.N.Z.		23-08-2011
										ELEC					CH. D.J.P.		ISSUE
										I&C						PE-189-IN-SK-8004(SH. 3 OF 10)	P0
										MECH							

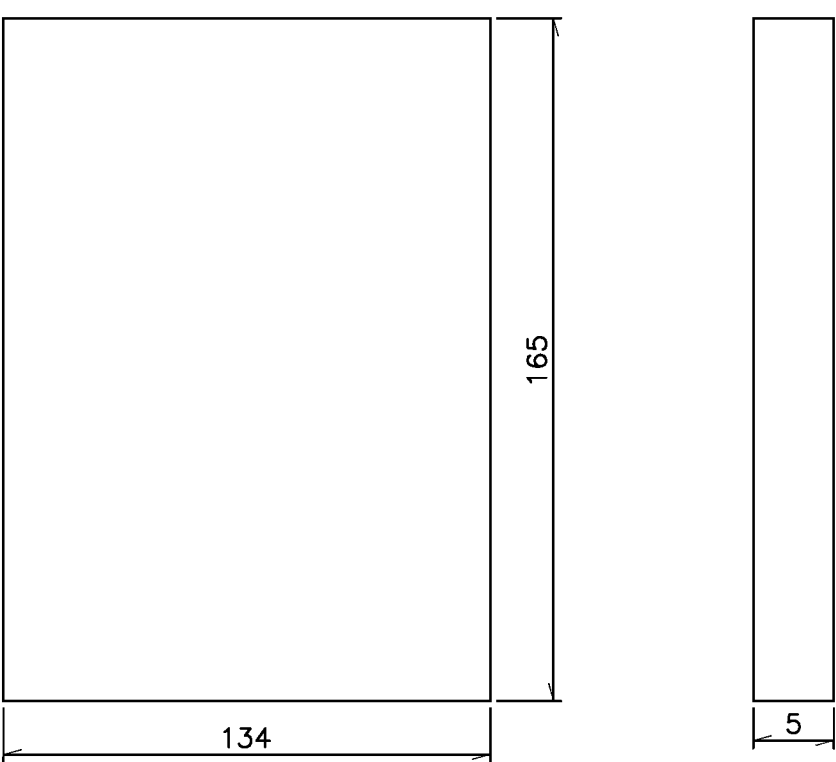
G.A. DRAWING OF CLEATS FOR
LOCAL INSTRUMENT RACK
DWG.NO. PE-189-IN-SK-8004
(SH. 4 OF 10)



DETAIL OF-1



DETAIL OF-2



DETAIL OF-3

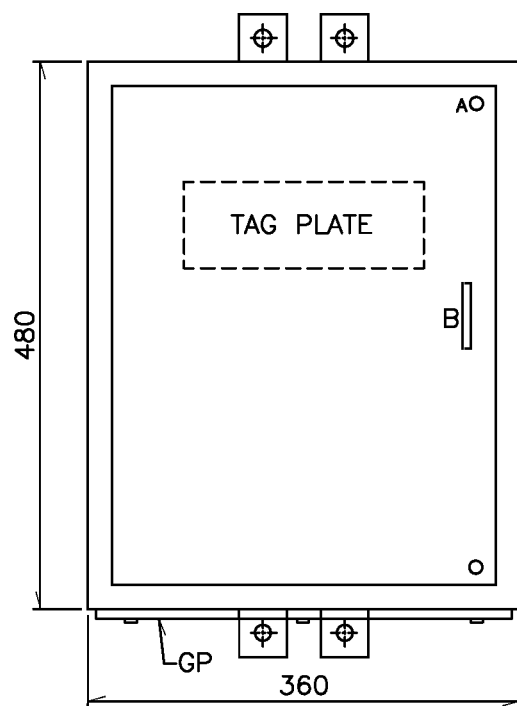
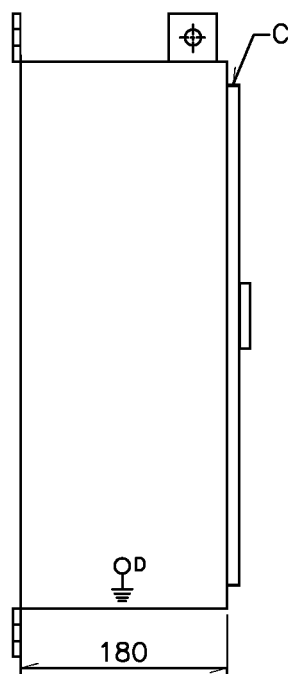
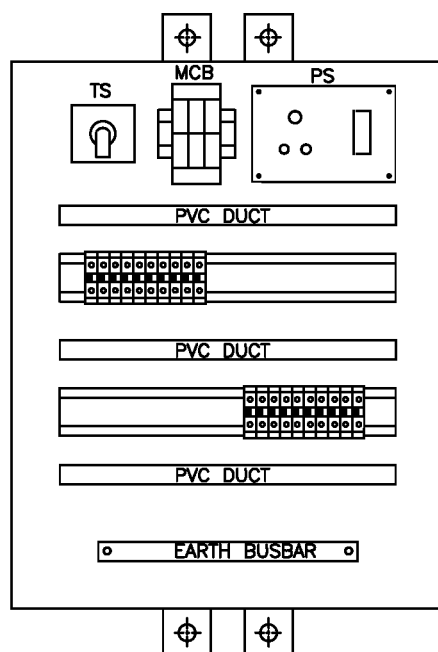
NOTES:

- 1. RIB M.S. PLATE 162.5 x 170 x 5 THICK.
- 2. RIB M.S. PLATE 125 x 170 x 5 HICK.
- 3. RIB M.S. PLATE 134 x 165 x 5 THICK.
- 4. ALL DIMENSIONS ARE IN mm
UNLESS OTHERWISE SPECIFIED.

FOR BID PURPOSE ONLY

DO NOT SCALE

ISSUE	REVISIONS	BY	CLEARED					APPD	DATE	FOR RO ISSUE ONLY			 MAHARASHTRA STATE POWER GENERATION CO.LTD. BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT G.A. DRAWING OF CLEATS FOR LOCAL INSTRUMENT RACK	PROCON ENGINEERS (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)					
			CHEM	CIVIL	ELEC	I&C	MECH			CLEARED				SCALE ~		APPROVED		DATE(RO ISSUE)	
									DEPT	SIGNATURE	DATE	DIV.		INST.	DR.	P.N.Z.	DWG.NO.	PE-189-IN-SK-8004 (SH. 4 OF 10)	ISSUE PO
									CHEM										
									CIVIL										
									ELEC										
									I&C										
									MECH										

FRONT VIEWSIDE VIEWINTERNAL FRONT VIEW**LEGEND:**

- A – DOOR LOCK
 B – DOOR HANDLE
 C – HINGES
 D – EARTH STUD
 GP – GLAND PLATE
 PS – POWER SOCKET
 TS – TOGGLE SWITCH
 TBS – TERMINAL BLOCKS

NOTES:

- JB WILL BE MADE OUT OF 2.0 mm CRCA SHEET.
- PROTECTION CLASS IP-65.
- COLOR: EXT.-RAL 7032, INT.-BRILLIANT WHITE.
- NUTS FOR MOUNTING THE JUNCTION BOX SHALL BE PROVIDED.
- 3 mm THICK CRCA GLAND PLATE (GP) AT BOTTOM SHALL BE PROVIDED.
- SCREWLESS CAGE CLAMP TERMINALS SHALL BE USED.
- EARTH BUS BAR SHALL BE OF 25x6 TINNED COPPER.
- INSTRUMENT TAG VIS-A-VIS SERVICE AND TERMINAL DETAILS SHALL BE PRINTED ON PHENOLIC BOARD MOUNTED ON BACK SIDE OF DOOR.
- COLOR CODE FOR POWER SUPPLY:
PHASE-RED, NEUTRAL-BLACK & EARTH – GREEN.
- CABLE FOR PANEL LIGHTING SHALL BE 1.5 SQ.mm, 1100V GRADE.
- SIGNAL WIRING SHALL BE 4Px0.5 SQ.mm TINNED COPPER, TWISTED PAIR, OVERALL SHIELDED 500V GRADE, FRLS PVC.
- ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.

FOR BID PURPOSE ONLY

ISSUE	BY	CH	DATE

PROCON ENGINEERS
 (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT. LTD.)

CLIENT : MAHARASHTRA STATE POWER GENERATION CO.LTD.

PROJECT : BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

DO NOT SCALE

DATE : 23-08-2011

G.A. OF JB LOCAL INSTRUMENT RACK

SCALE ~

APPROVED

DIV INST.

DR P.N.Z.

CH D.J.P.

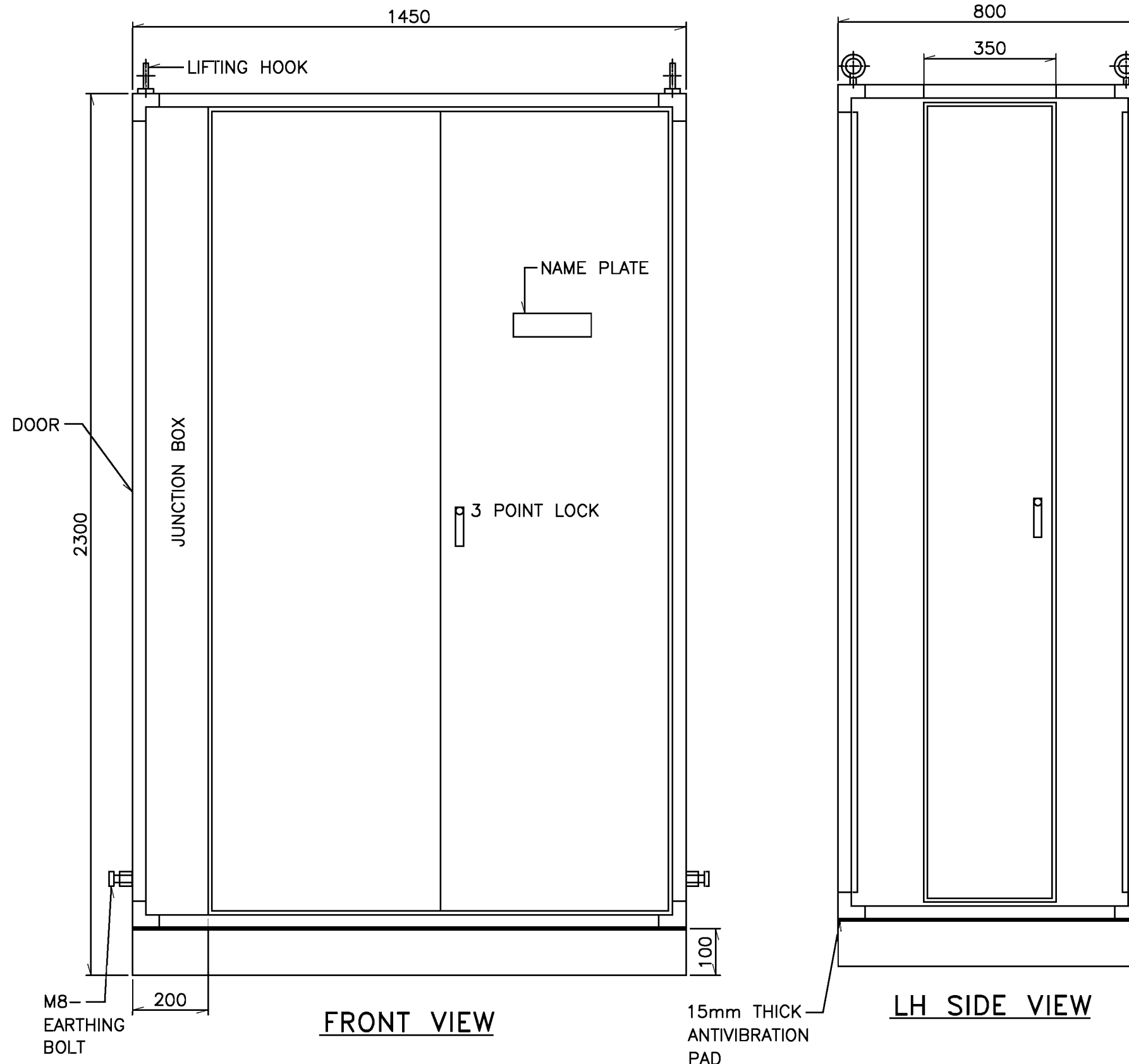
DWG.NO.PE-189-IN-SK-8004

(SHEET 5 OF 10)

PO

PE-189-IN-SK-8004 (SH. 6 OF 10)
G.A. DRAWING FOR
LOCAL INSTRUMENT ENCLOSURE

LOCAL INSTRUMENT ENCLOSURE



NOTES:

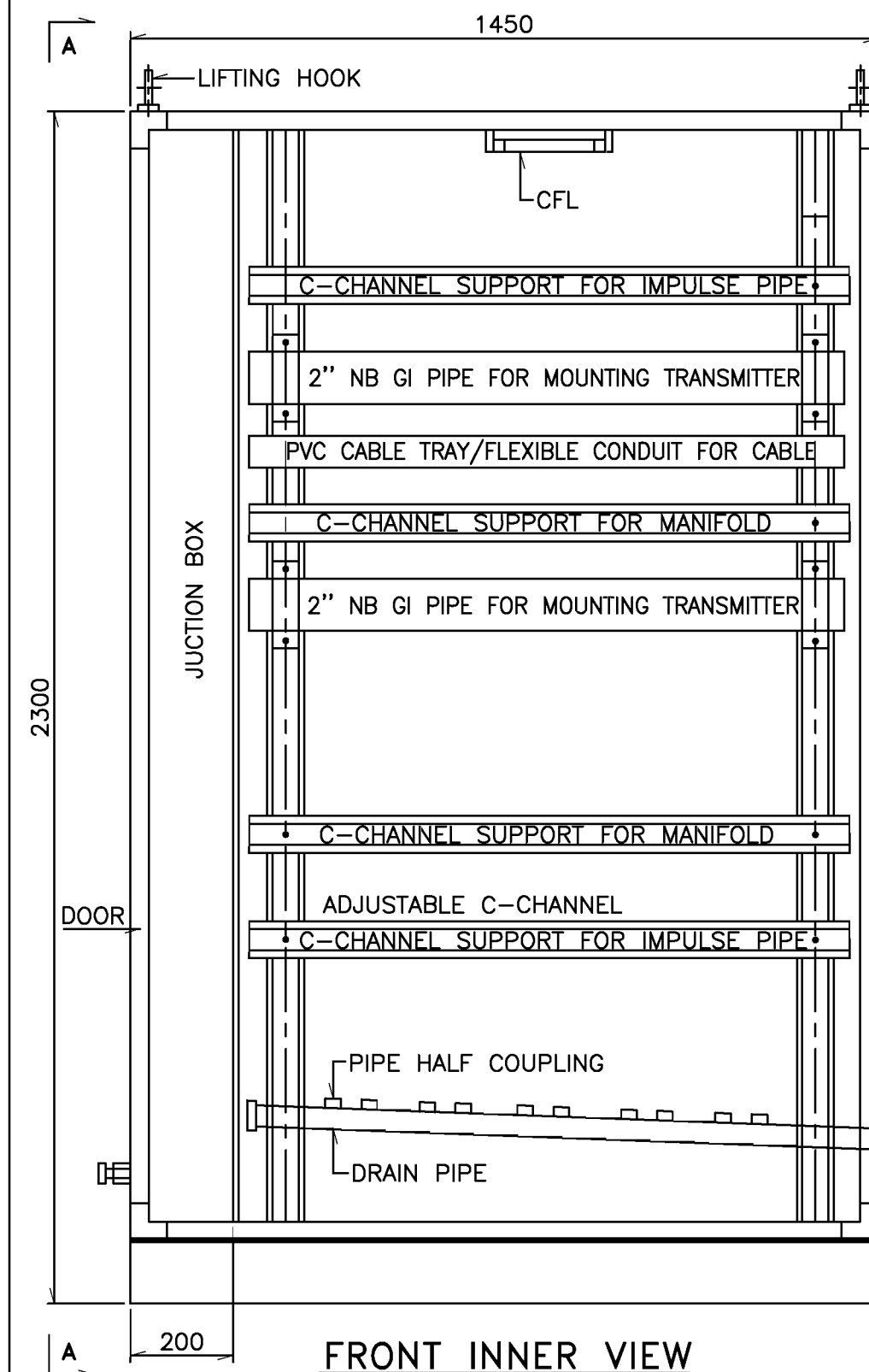
- DIMENSIONS SHOWN ARE TENTATIVE AND SHALL BE FINALIZED AT DETAILING.
- ALL SHEETS SHALL BE 3mm THICK CRCA SHEET.
- ALL DOORS SHALL BE FLUSH/CONCEALED TYPE.
- COLOR:
EXTERIOR : RAL 7032.
INTERIOR : BRILLIANT WHITE OVER ALL THICKNESS WILL BE > 100 MICRONS.
- BASE FRAME WILL BE MADE OUT OF ISMC 100 AND COLOR WILL BE BLACK PAINT FINISH.
- BULKHEAD PLATE FOR TOP AND BOTTOM SHALL BE 1150 x 650 x 6.
- CABLE GLAND PLATE OF THICKNESS 3mm CRCA SHEET SHALL BE PROVIDED BOTTOM OF JUCTION BOX.
- ENCLOSURE PROTECTION CLASS SHALL IP-65.
- TERMINALS INSIDE JUCTION BOX SHALL BE SCREWLESS CAGE CLAMP TYPE.
- DOORS SHALL BE PROVIDED WITH CONCEALED HINGES, THREE POINT LOCKING FOR FRONT, REAR AND SIDE DOOR HINGES SHALL BE OF STAINLESS STEEL.
- XLPE GASKET SHALL BE PROVIDED BETWEEN BULKHEAD PLATE & ENCLOSURE.
- EARTH BUSBAR 25 x 6 TINNED COPPER.
- DRAIN PIPE SLOPE SHALL BE 1:25 APPROX.
- COMMON LOCK/KEY SHALL BE PROVIDED FOR ALL LIE'S & JB'S.
- FOUNDATION BOLTS SHALL BE PROVIDED.
- TAG PLATES SHALL BE PROVIDED FOR EACH INSTRUMENTS.
- INSTRUMENT TAG VIS-A-VIS SERVICE AND TERMINAL DETAILS SHALL BE PRINTED ON PHENOLIC BOARD MOUNTED ON BACK SIDE OF JUNCTION BOX DOOR.
- 20% TERMINALS SHALL BE PROVIDED AS SPARE.
- NAME PLATE OF PANEL SHALL BE FIXED ON FRONT DOOR.
- ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.

FOR BID PURPOSE ONLY

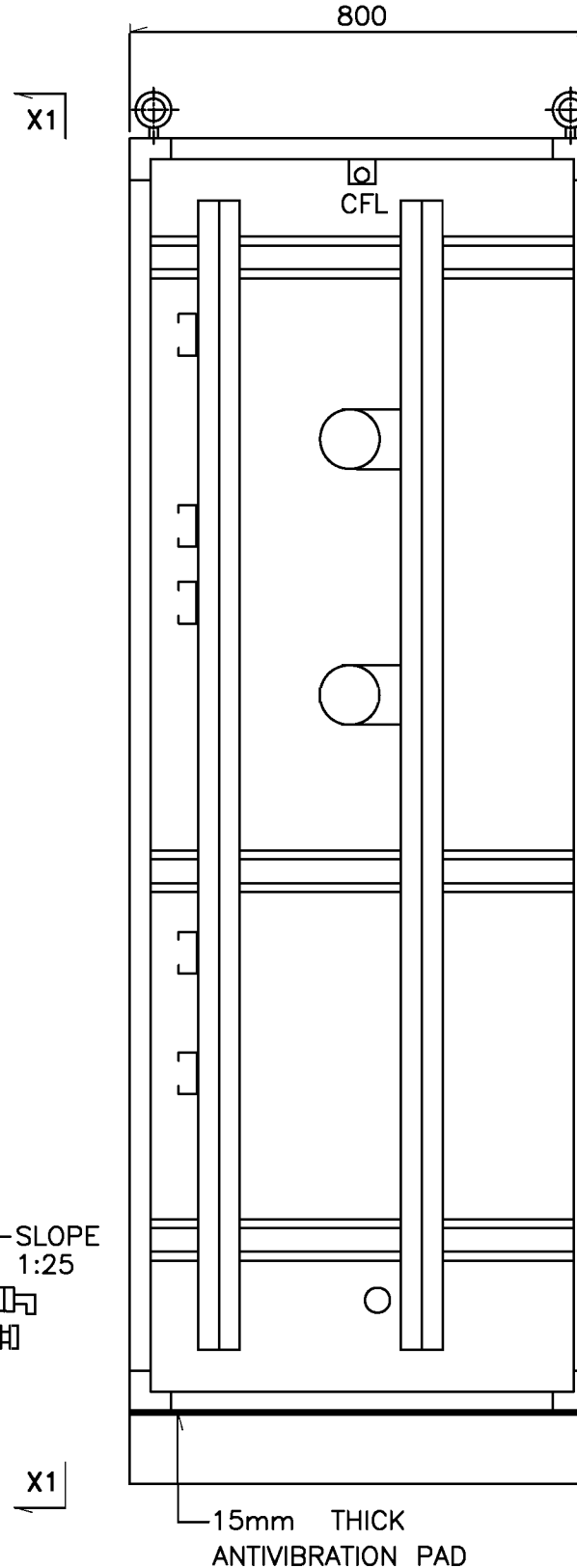
DO NOT SCALE

ISSUE	REVISIONS	BY	CLEARED					APPD	DATE	FOR RO ISSUE ONLY			 MAHARASHTRA STATE POWER GENERATION CO.LTD. BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT G.A. DRAWING FOR LOCAL INSTRUMENT ENCLOSURE	PROCON ENGINEERS (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
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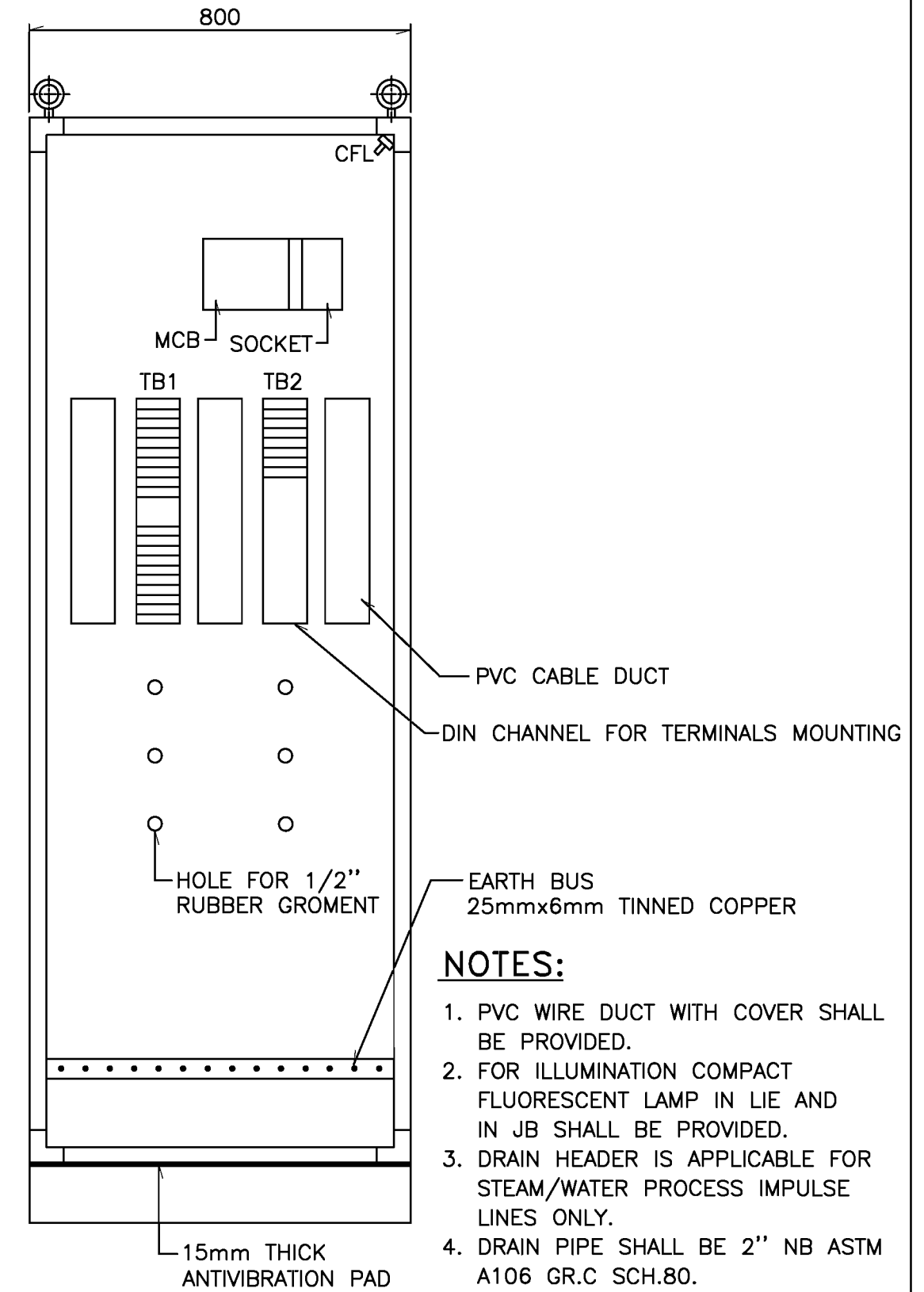
PE-189-IN-SK-8004 (SH. 7 OF 10)
 DWG. NO. TITLE
 INNER G.A. DRAWING FOR LOCAL INSTRUMENT ENCLOSURE



FRONT INNER VIEW



SIDE VIEW FROM X1-X1



SIDE VIEW FROM A-A

NOTES:

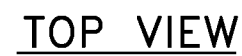
1. PVC WIRE DUCT WITH COVER SHALL BE PROVIDED.
2. FOR ILLUMINATION COMPACT FLUORESCENT LAMP IN LIE AND IN JB SHALL BE PROVIDED.
3. DRAIN HEADER IS APPLICABLE FOR STEAM/WATER PROCESS IMPULSE LINES ONLY.
4. DRAIN PIPE SHALL BE 2" NB ASTM A106 GR.C SCH.80.
5. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.

FOR BID PURPOSE ONLY

DO NOT SCALE

ISSUE	REVISIONS	BY	CLEARED					APPD	DATE	FOR RO ISSUE ONLY			"P" (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION / FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK. CONSTRUCTION / FABRICATION WORK IS PERMITTED ON "R" (RELEASED) ISSUES ONLY. INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION / FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR 'HOLDS' IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION / FABRICATION WORK RELATED TO 'HOLDS'. DRAWINGS SIGNED BY PROCON ENGINEERS AUTHORIZED REPRESENTATIVE ONLY ARE VALID DRAWINGS.	 MAHAGENCO	MAHARASHTRA STATE POWER GENERATION CO.LTD. BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT	PROCON ENGINEERS (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											
			CHEM	CIVIL	ELEC	I&C	MECH			DEPT	SIGNATURE	DATE				SCALE ~	APPROVED	DATE(RO ISSUE)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
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INNER G.A. DRAWING FOR
LOCAL INSTRUMENT ENCLOSURE



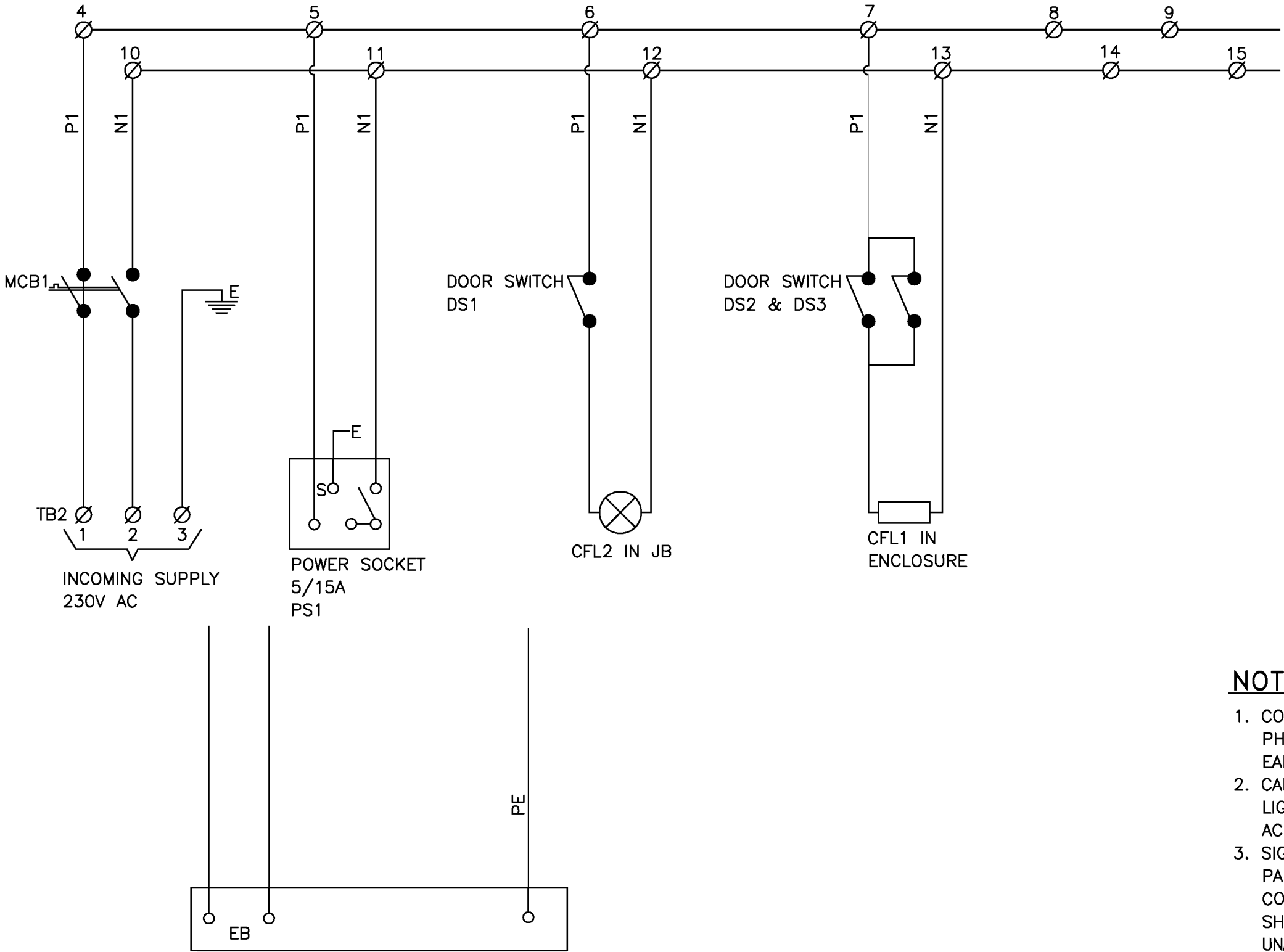
1. BULK HEAD PLATE DIMENSION ARE 1150 x 650 x 6.
2. IMPULSE PIPE ENTRY: BOTTOM ENTRY FOR AIR/FLUE GAS APPLICATIONS.
3. IMPULSE ENTRY: TOP ENTRY FOR STEAM/WATER APPLICATIONS.
4. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE SPECIFIED.

FOR BID PURPOSE ONLY

[illegible]

THIS ELECTRICAL WIRING AND TERMINATION DRAWING FOR LOCAL INSTRUMENT ENCLOSURE
DWG.NO. PE-189-IN-SK-8004 (SH. 9 OF 10)

POWER WIRING CIRCUIT



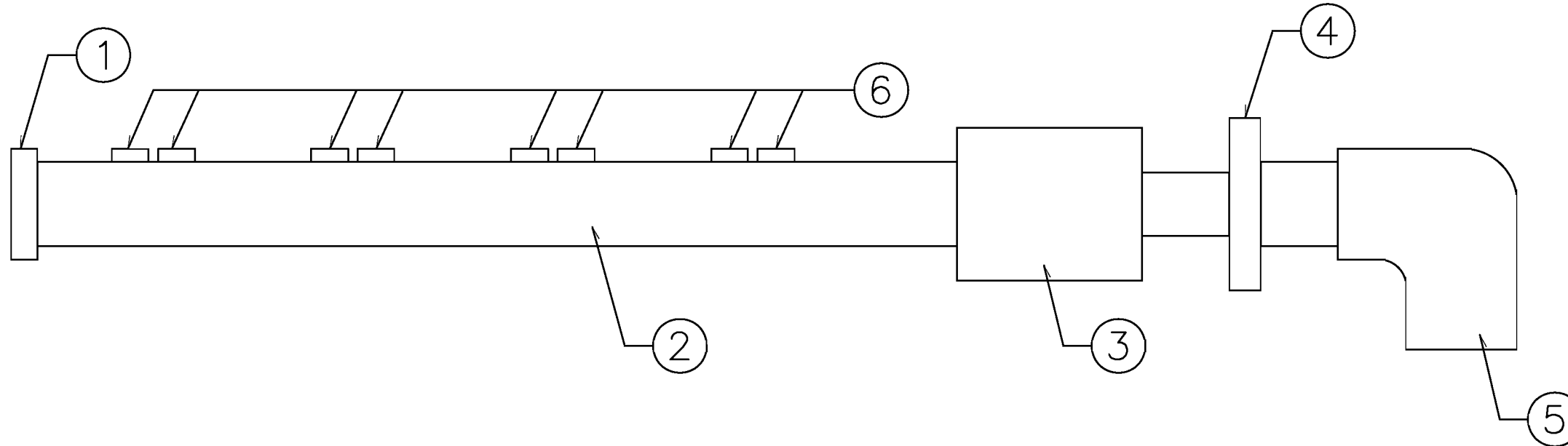
NOTES:

1. COLOR CODING FOR POWER SUPPLY: PHASE-RED, NEUTRAL-BLACK AND EARTH-GREEN.
2. CABLE ROUTING FROM TB TO PANEL LIGHT WILL BE 1.5 sq.mm 1100V AC GRADE.
3. SIGNAL WIRING WILL BE DONE BY 4 PAIR x 0.5 sq.mm ANNEALED TINNED COPPER, PAIR TWISTED OVERALL & SHIELDED, VOLTAGE GRADE 1100V, UNARMoured FRLS PVC SHIELDED CABLE.

FOR BID PURPOSE ONLY

DO NOT SCALE

ISSUE	REVISIONS	BY	CLEARED					APPD	DATE	FOR RO ISSUE ONLY			"P" (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION / FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK. CONSTRUCTION / FABRICATION WORK IS PERMITTED ON "R" (RELEASED) ISSUES ONLY. INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION / FABRICATION. FIELD MUST GET DESIGN OFFICE TO CLEAR 'HOLD' IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION / FABRICATION WORK RELATED TO 'HOLD'. DRAWINGS SIGNED BY PROCON ENGINEERS' AUTHORISED REPRESENTATIVE ONLY ARE CONSIDERED VALID DRAWINGS.	 MAHARASHTRA STATE POWER GENERATION CO.LTD. BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT	PROCON ENGINEERS (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)			
			CHEM	CIVIL	ELEC	I&C	MECH			DEPT	SIGNATURE	DATE			SCALE ~	APPROVED		DATE(RO ISSUE)
										CHEM					DIV. INST.		DATE(CURRENT ISSUE) 23-08-2011	
										CIVIL					DR. P.N.Z.			
										ELEC					CH. D.J.P.	DWG.NO. PE-189-IN-SK-8004 (SH. 9 OF 10)	ISSUE P0	
										I&C								
										MECH								



BILL OF MATERIAL		
SL. NO.	DESCRIPTION	QTY.
1	2" S.W. CAP, CS	1
2	2" NB, ASTM A-106, SCH 80/GR. C	1
3	2" SW x 1" NPT(F) COUPLING, CS	1
4	1" NPT(M) x 1" BSP(M) HEX. NIPPLE WITH FITTING, CS	1
5	1" BSP(F) ELBOW, CS (BOTH ENDS THREADED)	1
6	HALF COUPLING; SIZE; 1/2" NB SW	AS REQD.

DO NOT SCALE

ISSUE	REVISIONS	BY	CLEARED					APPD	DATE	FOR RO ISSUE ONLY			*P* (PRELIMINARY) ISSUES ARE NOT TO BE USED FOR CONSTRUCTION / FABRICATION BUT ARE ISSUED FOR LIMITED PURPOSES ONLY AS INDICATED IN THE SMALL BLOCK AT THE TOP RIGHT HAND CORNER OF THE TITLE BLOCK. CONSTRUCTION / FABRICATION WORK IS PERMITTED ON 'R' (RELEASED) ISSUES ONLY. INFORMATION CONTAINED WITHIN 'HOLD' IS NOT RELEASED FOR CONSTRUCTION / FABRICATION. FIELD MUST GET TO DESIGN OFFICE TO 'HOLDS' IN TIME BEFORE PROCEEDING WITH ANY CONSTRUCTION / FABRICATION WORK RELATED TO 'HOLDS'. DRAWINGS SIGNED BY PROCON ENGINEERS' AUTHORIZED REPRESENTATIVE ONLY ARE VALID FOR CONSTRUCTION.	 MAHARASHTRA STATE POWER GENERATION CO.LTD. BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT	PROCON ENGINEERS (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)			
			CHEM	CIVIL	ELEC	I&C	MECH			DEPT	SIGNATURE	DATE			SCALE ~	APPROVED	DATE(RO ISSUE)	
										CHEM					DR. INST.		DATE(CURRENT ISSUE)	
										CIVIL					DR. P.N.Z.		23-08-2011	
										ELEC								
										I&C								
										MECH								
DRAIN HEADER DETAIL FOR LOCAL INSTRUMENT ENCLOSURE															DWG.NO. PE-189-IN-SK-8004 (SH. 10 OF 10)	ISSUE NO. PO		

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

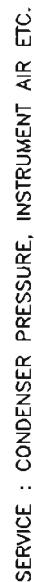
				FOR BID PURPOSE ONLY	
				DO NOT SCALE	DATE : 23-08-2011
ISSUE	BY	CH	DATE	TYPICAL INSTRUMENT INSTALLATION DIAGRAM	
				PROCON ENGINEERS (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT. LTD.)	
				CLIENT : MAHARASHTRA STATE POWER GENERATION CO.LTD. PROJECT : BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT	
				SCALE ~ DIV INST. DR P.N.Z. CH D.J.P.	APPROVED DWG.NO.PE-189-IN-SK-8003 (SH. 1 of 20) PD

NOTES:

1. PROVISION OF SINGLE OR DOUBLE ROOT VALVE AND DRAIN VALVE SHALL BE IN ACCORDANCE WITH THE PRESSURE/ TEMPERATURE REQUIREMENT. FOR LINE PRESSURE EQUAL TO OR GREATER THAN 40 KG/SQ. CM. 2 NOS ROOT VALVE AND 2 NOS DRAIN VALVE SHALL BE REQUIRED.
2. MATERIAL, SIZE AND RATING OF THE PROCESS HOOK UP ITEMS SHOWN IN THE DRAWING ARE INDICATIVE ONLY. ACTUAL REQUIREMENT SHALL BE AS PER PROCESS CONDITION AND SPECIFICATION OF CONTROL & INSTRUMENTATION.
3. DRAIN PIPE IN RACK AND ENCLOSURE SHALL BE 2" NB SCH 80.

				FOR BID PURPOSE ONLY	
				DO NOT SCALE	DATE : 23-08-2011
ISSUE	BY	CH	DATE	TYPICAL INSTRUMENT INSTALLATION DIAGRAM	
				PROCON ENGINEERS (DIVISION OF NIMOTO CONSULTING ENGINEERS PVT. LTD.)	
				CLIENT : MAHARASHTRA STATE POWER GENERATION CO.LTD. PROJECT : BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT	
				SCALE ~ DIV INST. DR P.N.Z. CH D.J.P.	APPROVED DWG.NO. PE-189-IN-SK-8003 (Srl. 2 of 20) PD

PRESSURE TRANSMITTER/
SWITCH



DO NOT SCALE

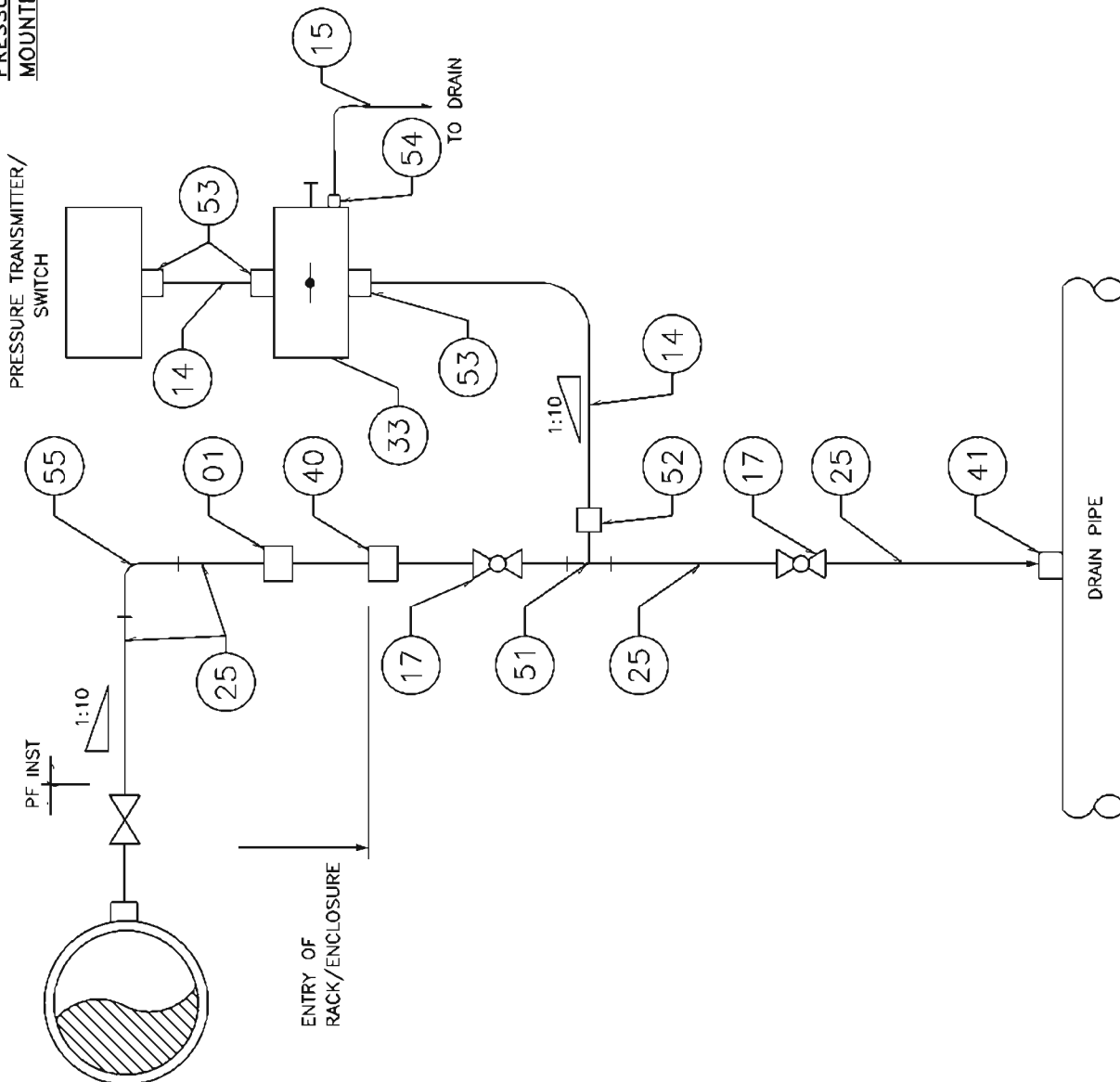
PROCON ENGINEERS (DIVISION OF MIKOTO CONSULTING ENGINEERS PVT.LTD.)		DATE(PO ISSUE)
APPROVED		DATE(CORRECT ISSUE)
INST.		23-08-2011
P.N.Z.		
D.J.P.		DRG.NO. PE-188-N-SK-8003 (Rev. 3 of 20) PO

MAHARASHTRA STATE POWER GENERATION CO.LTD.
BHUSAWAL T.P.S. UNIT-6 ; 1 X 660 MW PROJECT

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

[illegible][illegible]

**PRESSURE TRANSMITTER/PRESSURE SWITCH
MOUNTED BELOW SOURCE POINT**



BILL OF MATERIAL		
ITEM NO.	QTY./INST	DESCRIPTION
51	1	EQUAL TEE (FEMALE) 1/2" SW 6000lbs, CS/AS
52	1	MALE CONNECTOR 1/2" PE x 1/2" OD 6000I lbs, CS/AS
17	2	GLOBE VALVES 1/2" SW 800lbs, CS/AS
14	3 MTRS.	TUBE 1/2" OD, 2.1mm THK, SS 316
53	3	MALE CONNECTOR 1/2" NPT(M) x 1/2" OD 6000 lbs, SS 316
25	15 MTRS.	IMPULSE PIPE 15 NB GR.B SCH 80, CS/AS
33	1	2 VALVES MANIFOLD 1/2" NPT(F), SS 316
01	1	FULL COUPLING 1/2" SW 6000lbs, CS/AS
15	0.15 MTRS.	TUBE 8mm OD, 1.0mm THK, SS 316
54	1	MALE CONNECTOR 1/4" NPT(M) x 8mm OD 6000 lbs, SS 316
55	2	90° ELBOW 1/2" SW 6000lbs, CS/AS
40	1	BULKHEAD UNION/COUPLING CL-6000 lbs, 1/2"NB-SW, AS PER ANSI B16.11, CS/AS
41	1	HALF COUPLING CL-6000 lbs, 1/2" NB-SW, AS PER ANSI B16.11, CS/AS

SERVICE : CONDENSATE, FEED WATER ETC.

FOR BID PURPOSE ONLY

DO NOT SCALE	
PROCON ENGINEERS (DAVISBORO OF MARGO CONSULTING ENGINEERS PVT.LTD.)	
SCALE ~	DATE (DD MM YY)
DNV. INST.	APPROVED
DNV. P.N.Z.	DATE (DD MM YY)
DNV. D.J.P.	DATE (DD MM YY)
PE-189-IN-SK-8003 (Rev. 4 of 20) P.0	

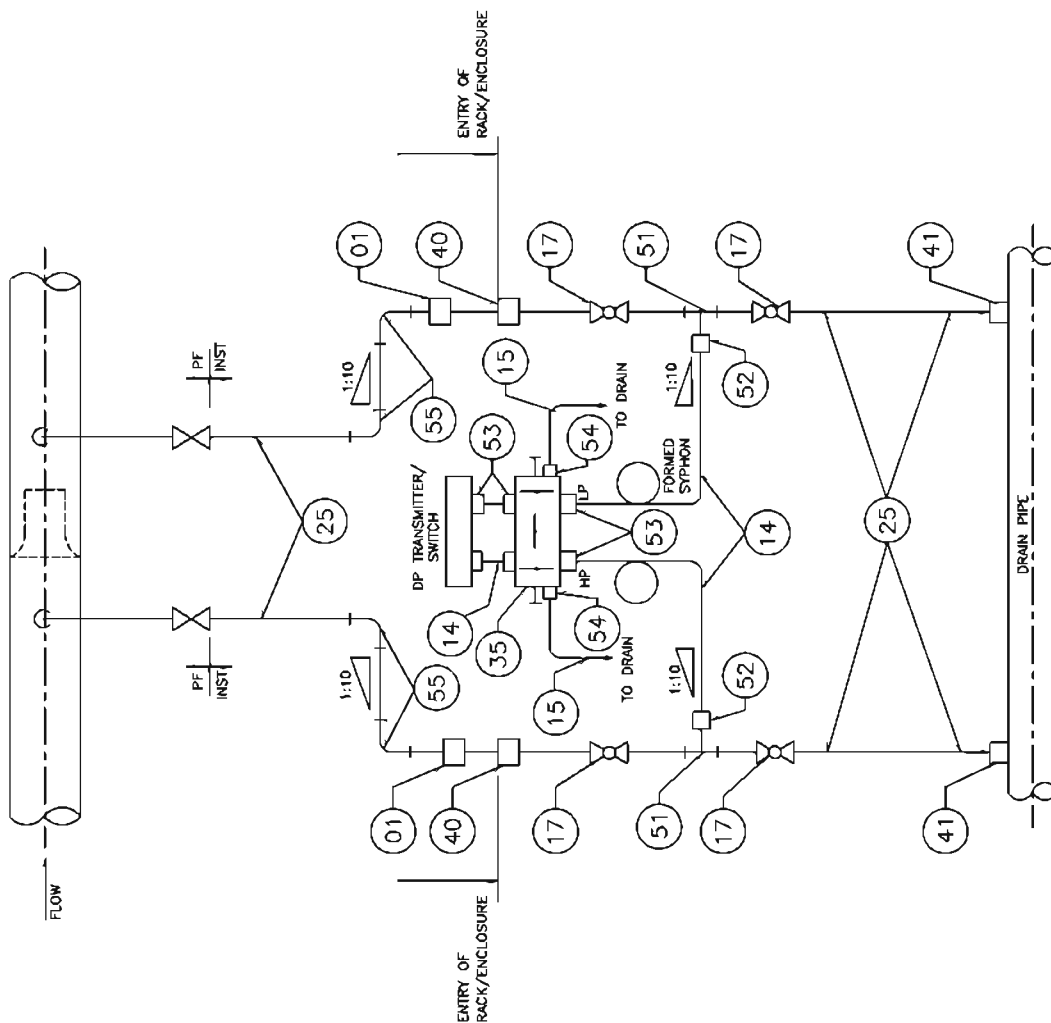
MAHARASHTRA STATE POWER GENERATION CO.LTD.	
BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT	
TYPICAL INSTRUMENT INSTALLATION DIAGRAM	

FOR RD ISSUE ONLY	
CHECKED	DATE
SIGNATURE	DATE
DEPT	DATE
CHEM	DATE
CIVIL	DATE
ELEC	DATE
IMC	DATE
MECH	DATE

ISSUE	REVISIONS	BY	CHECKED	DATE

TITLE	TYPICAL INSTRUMENT INSTALLATION DIAGRAM	ORIG. NO. PE-189-IN-SK-8003 REV. 7-8-89
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DIFF. PRESS. TRANSMITTER/ DIFF. PRESS. SWITCH
MOUNTED BELOW SOURCE POINT



SERVICE ; CONDENSATE, FEED WATER ETC.
PRIMARY ELEMENT ; FLOW NOZZLE/ORIFICE.

FOR BID PURPOSE ONLY

MAHARASHTRA STATE POWER GENERATION CO. LTD.
 BHUSAVAL T.P.S. UNIT - 6 : 1 X 880 MW PROJECT
 DO NOT SCALE

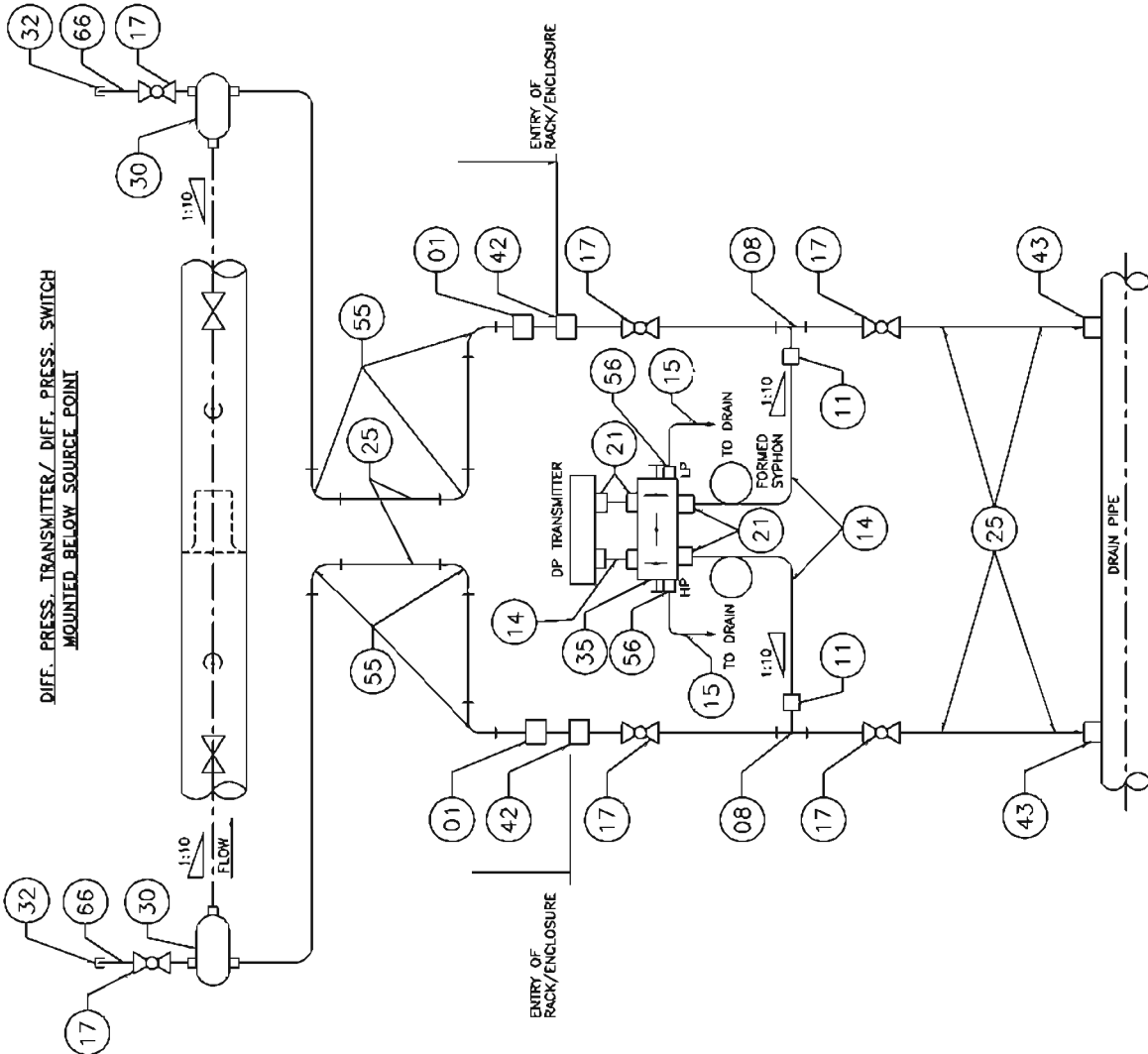
TYPICAL INSTRUMENT INSTALLATION DIAGRAM

PROCON ENGINEERS

SCALE	~			DATE (NO ISSUES)
DIV.	INST.	APPROVED		DATE (CURRENT ISSUES)
				23-08-2011
DR.	P.N.Z.			
CH.	D.J.P.			
		DWG.NO.	PE-189-N-SK-8003	ISSUE
				REV. 0 (P. 03)
				P0

[illegible]

DATE
TYPICAL INSTRUMENT
INSTALLATION DIAGRAM
DWG NO.
PE-189-IN-SK-8003
REV. 01 OF 01



BILL OF MATERIAL	
ITEM NO.	QTY./ INST. DESCRIPTION
08	2 EQUAL TEE (FEMALE) 1/2" SW 9000lbs. CS/AS
11	2 MALE CONNECTOR 1/2" PE x 1/2" OD 9000 lbs. CS/AS
17	6 GLOBE VALVES 1/2" SW 800lbs. CS/AS
14	6 MTRS. TUBE 1/2" OD. 2.1mm THICK. SS 316
21	6 MALE CONNECTOR 1/2" NPT(M) x 1/2" OD 9000 lbs. SS 316
25	30 MTRS. IMPULSE PIPE 15 NB GR.B SCH 80. CS/AS
35	1 5 VALVE MANIFOLD 1/2" SE 9000 lbs. SS 316
01	2 FULL COUPLING 1/2" SW 9000lbs. CS/AS
30	2 CONDENSATE POT 1/2" SW NPT(F) 9000lbs. CS/AS
32	2 PLUG 1/2" NPT(F) 9000lbs. CS/AS
15	0.3 MTRS. TUBE 8mm OD. 1.0mm THICK. SS 316
56	2 MALE CONNECTOR 1/4" NPT(M) x 8mm OD 9000 lbs. SS 316
55	6 90° ELBOW 1/2" SW 9000lbs. CS/AS
42	2 BULKHEAD UNION/COUPLING CL-9000 lbs. AS PER ANSI B16.11, 1/2" NB-SW. CS/AS
43	2 HALF COUPLING CL-9000 lbs/ 1/2" NB-SW. AS PER ANSI B16.11, CS/AS
66	2 15 NB SCH 80. SW x 1/2" NPT(M).SEAMLESS NIPPLE 6000 lbs. CS/AS

SERVICE : STEAM
PRIMARY ELEMENT : FLOW NOZZLE/ORIFICE.

FOR BID PURPOSE ONLY

DO NOT SCALE
MAHARASHTRA STATE POWER GENERATION CO.LTD.
BHUSAWAL T.P.S. UNIT-6 : 1 X 860 MW PROJECT

TYPICAL INSTRUMENT
INSTALLATION DIAGRAM

PROCON ENGINEERS
(DIVISION OF NIMOTO CONSULTING ENGINEERS PVT.LTD.)

SCALE	~	DATE (NO ISSUE)
DW. INST.	APPROVED	DATE (JUN08 664)
DR. P.N.Z.		23-08-2011
CH. D.J.P.		DWG.NO. PE-189-IN-SK-8003 ISSUE P0

IF PRELIMINARY ISSUES ARE NOT TO BE USED FOR CONSTRUCTION/INSTALLATION BUT FOR REFERENCE ONLY, THE TITLE BLOCK MUST BE PLACED IN THE RIGHT HAND CORNER OF THE TITLE BLOCK. INFORMATION CONTAINED WITHIN 'HELP' IS NOT TO BE USED FOR CONSTRUCTION/INSTALLATION. FIELD MUST GET PERSON OFFICE TO CLONED. FIELD MUST GET PERSON OFFICE TO CLONED. INFORMATION CONTAINED WITHIN 'HELP' IS NOT TO BE USED FOR CONSTRUCTION/INSTALLATION. FIELD MUST GET PERSON OFFICE TO CLONED. INFORMATION CONTAINED WITHIN 'HELP' IS NOT TO BE USED FOR CONSTRUCTION/INSTALLATION. FIELD MUST GET PERSON OFFICE TO CLONED.

FOR RO ISSUE ONLY	
CLEAR	DATE
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CHEM	
CIVIL	
ELEC	
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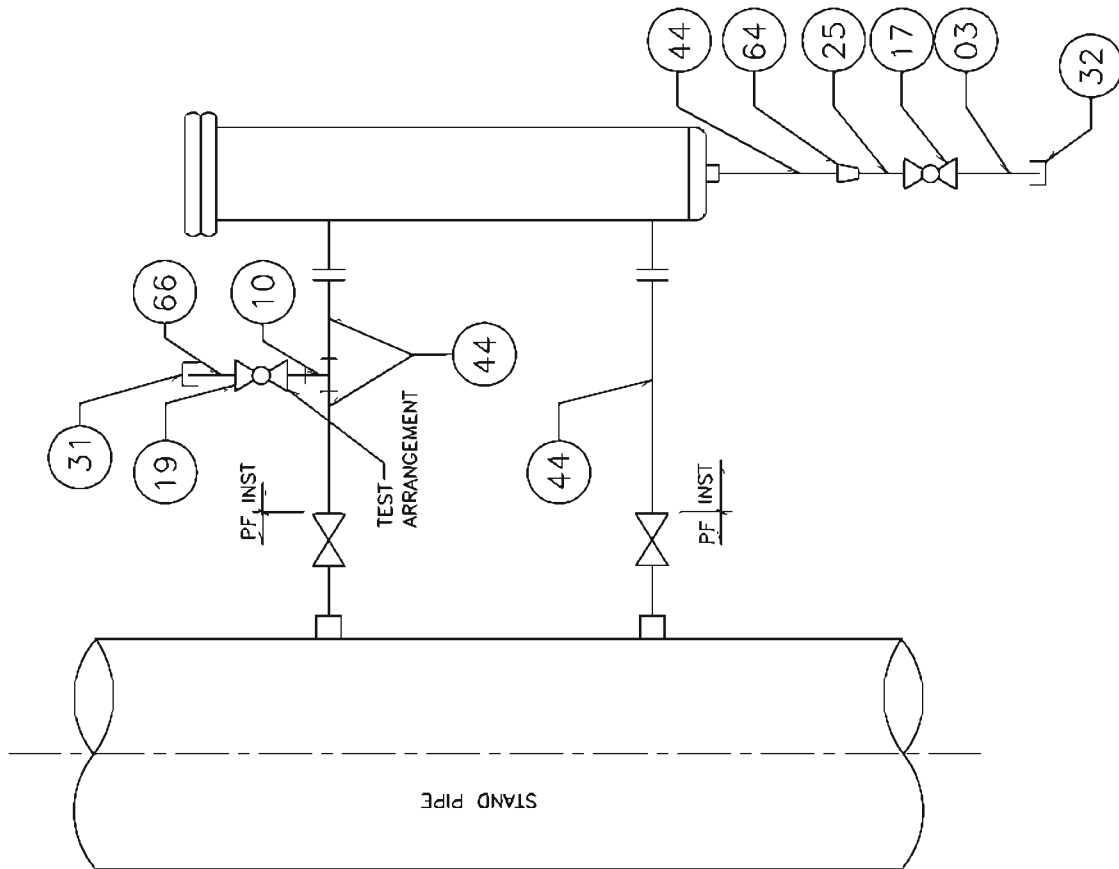
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CIVIL	MECH

BY	
CHEM	ELEC
CIVIL	MECH

REVISIONS	
DATE	APPD
DATE	MECH

ISSUE	
DATE	APPD
DATE	MECH

FLOAT OPERATED LEVEL SWITCH



SERVICE : CONDENSATE.

BILL OF MATERIAL		
ITEM NO.	QTY./INST	DESCRIPTION
17	1	GLOBE VALVES 1/2" SW 800lbs, CS/AS
25	0.5 MTRS.	IMPULSE PIPE 15 NB SCH 80, CS/AS
32	1	PLUG 1/2" NPT(M) 3000lbs, CS/AS
10	2	EQUAL TEE (FEMALE) 1" SW 3000lbs, CS/AS
44	2 MTRS.	IMPULSE PIPE 25 NB SCH 80, CS/AS
64	1	REDUCER 1" SW x 1/2" SW 3000lbs, CS/AS
19	1	GLOBE VALVES 1" SW 800lbs, CS/AS
31	1	PLUG 1" NPT(F) 3000lbs, CS/AS
66	1	1" NB SCH 80 SW x 1" NPT(M) SEAMLESS NIPPLE 3000 lbs, CS/AS
03	1	15 NB SCH 80 SW x 1/2" NPT(M) SEAMLESS NIPPLE 3000lbs, CS/AS

FOR BID PURPOSE ONLY

DO NOT SCALE		PROCON ENGINEERS (DIVISION OF HUNTO CONSULTING ENGINEERS PVT.LTD.)	
SCALE	~	DATE	23-08-2011
BY	INST.	APPROVED	
BY	P.N.Z.	DATE	23-08-2011
BY	D.J.P.	DATE	23-08-2011

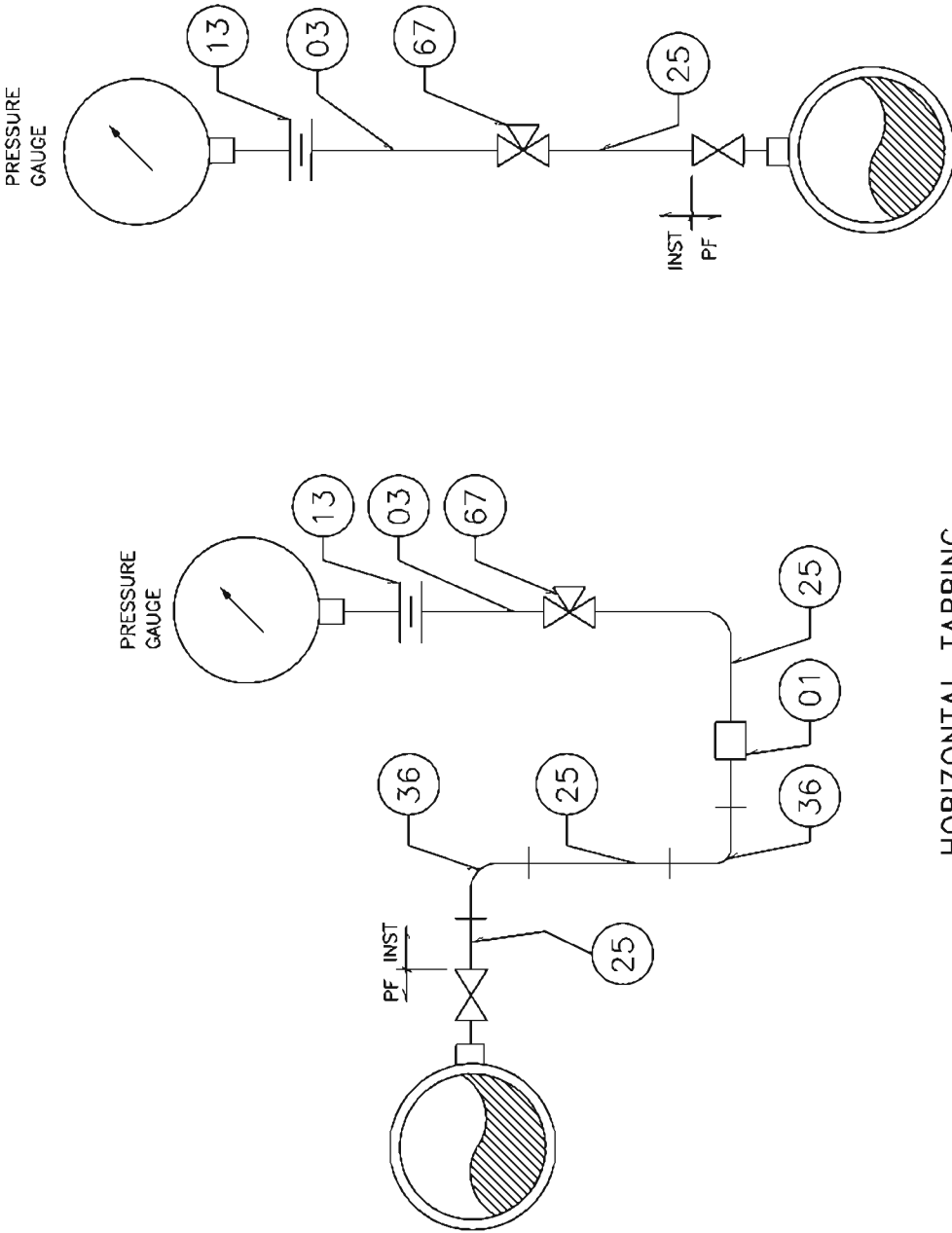
MAHARASHTRA STATE POWER GENERATION CO.LTD.	MAHARASHTRA STATE POWER GENERATION CO.LTD.
BRUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT	BRUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT
TYPICAL INSTRUMENT INSTALLATION DIAGRAM	TYPICAL INSTRUMENT INSTALLATION DIAGRAM

FOR RO ISSUE ONLY	CLEAR	DATE	APPR	DATE
DEPT	SIGNATURE	DATE		
CHEM				
CIVIL				
ELEC				
MECH				

BY	CHEM	CIVIL	ELEC	MECH

REVISIONS	DATE	BY	REVISIONS

ISSUE	DATE	BY	REVISIONS



SERVICE : WATER, CONDENSATE ETC.

FOR BID PURPOSE ONLY

ISSUE	REVISIONS	BY	CHECKED	DATE	APPROVED	DATE

FOR RO ISSUE ONLY			
DEPT	SIGNATURE	DATE	
CHEM			
CIVIL			
ELEC			
MECH			

DO NOT SCALE			
PROCON ENGINEERS			
DIVISION OF MECHANICAL CONSULTING ENGINEERS (PVT) LTD.			
SCALE	APPROVED	DATE/RO ISSUED	
1:1			
DNV	INST.		
DNV	P.N.Z.	23-08-2011	
CH	D.J.P.	23-08-2011	

MAHARASHTRA STATE POWER GENERATION CO. LTD.
BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

TYPICAL INSTRUMENT
INSTALLATION DIAGRAM

PE-189-IN-SK-8003 Rev 11 of 20

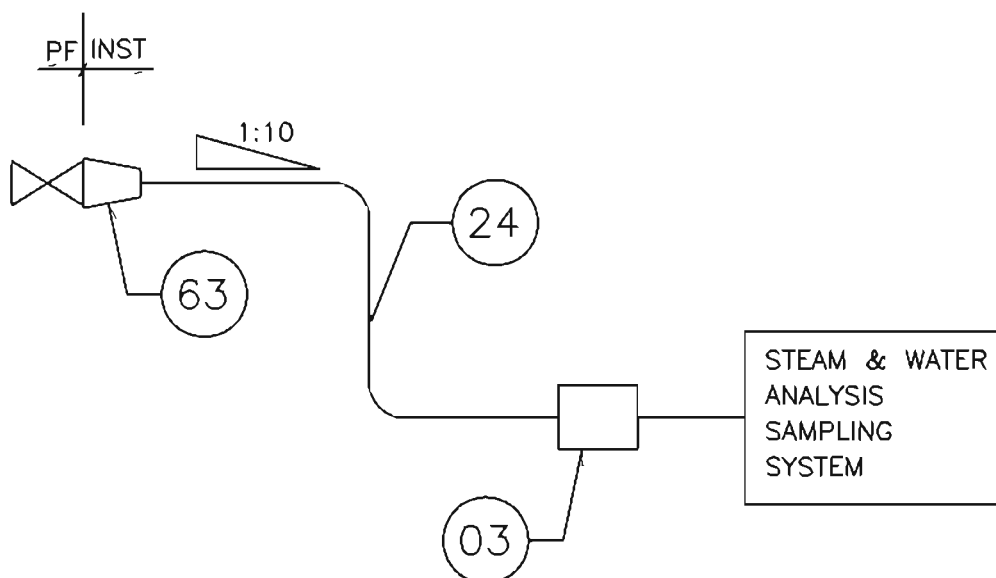
SERVICE : STEAM, FEED WATER.



VERTICAL TAPPING

FOR BID PURPOSE ONLY

Page 368 of 3099

FOR SWAS

BILL OF MATERIAL

ITEM NO.	QTY./ INST	DESCRIPTION
03	1	FULL COUPLING 1/2" SW 6000lbs, CS/AS
63	1	REDUCER 1" SW x 1/2" SW 6000lbs, CS/AS
24	A/R	IMPULSE PIPE 15 NB SCH 80, CS/AS

LEGEND:

A/R – AS PER REQUIREMENT

FOR BID PURPOSE ONLY

DO NOT SCALE

DATE : 23-08-2011

ISSUE BY CH DATE

PROCON ENGINEERS
(DIVISION OF NIMOTO CONSULTING ENGINEERS PVT. LTD.)

CLIENT : MAHARASHTRA STATE POWER GENERATION CO.LTD.

PROJECT : BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

SCALE ~

APPROVED

DIV INST.

DR P.N.Z.

CH D.J.P.

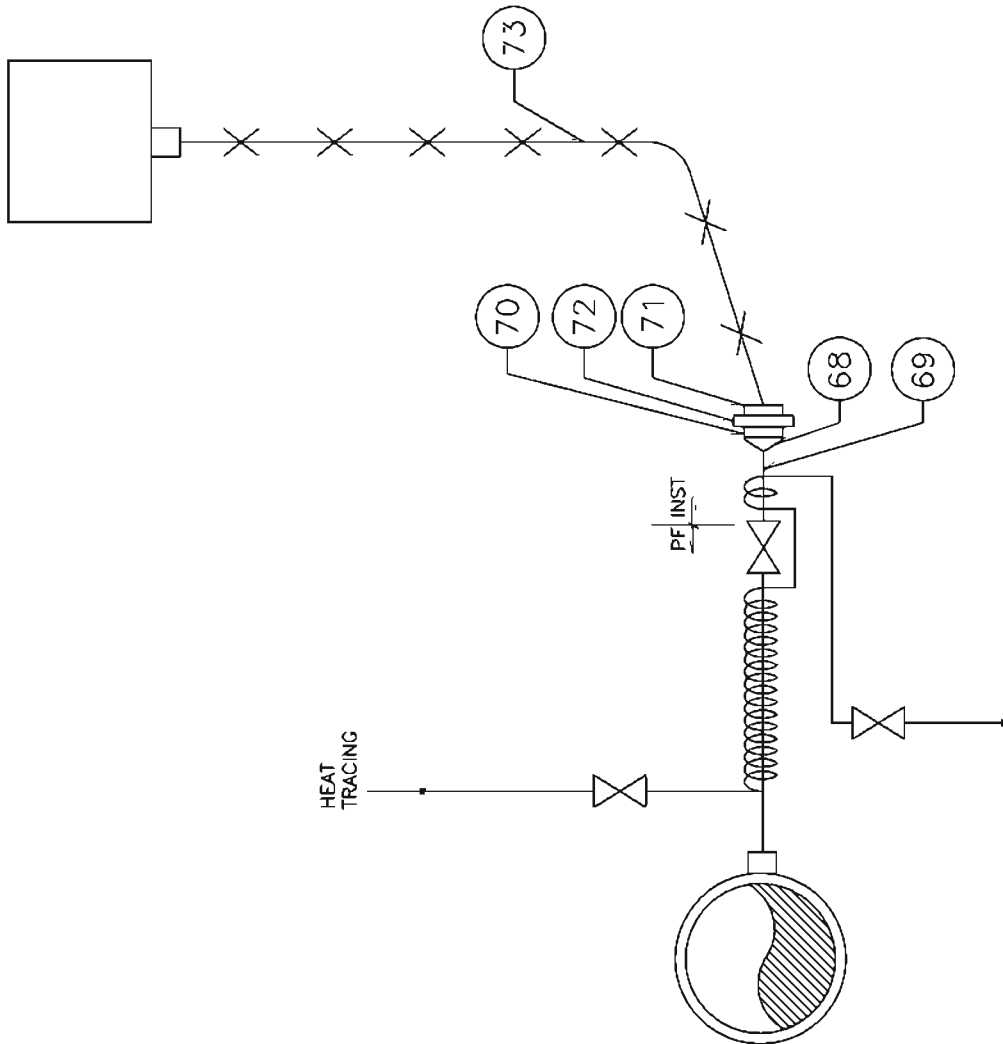
DWG.NO.PE-189-IN-SK-8003

SHEET 13 OF 20

PD

PRESSURE TRANSMITTER/ PRESSURE SWITCH
IN HFO SERVICE

PRESSURE TRANSMITTER/
SWITCH



BILL OF MATERIAL		
ITEM NO.	QTY./INST	DESCRIPTION
73	A/R	INSTRUMENT CAPALLARY TUBE
72	1	SEAL DIAPHRAGM
69	1	1" NPS SCH-80 CS/AS NIPPLE
71	1	2" 300 lbs ANSI FLANGE SUPPLIED ALONG WITH INSTRUMENT
70	1	2" 300 lbs, ANSI FLANGE WELD NECK.
68	1	1" x 2" CS/AS EXPANDER, SW

LEGEND:

A/R - AS PER REQUIREMENT.

NOTE:

1. QUANTITY IN COLUMNS TO BE DOUBLED FOR DP MEASUREMENT.

FOR BID PURPOSE ONLY

DO NOT SCALE	
PROCON ENGINEERS (DIVISION OF MARGO CONSULTING ENGINEERS PVT.LTD.)	
SCALE ~	DATE (RD ISSUE)
DNV. INST.	APPROVED
DNV. P.N.Z.	DATE (RD ISSUE)
DNV. D.J.P.	DATE (RD ISSUE)
PE-189-IN-SK-8003 (Rev. 11 of 30) P.O.	

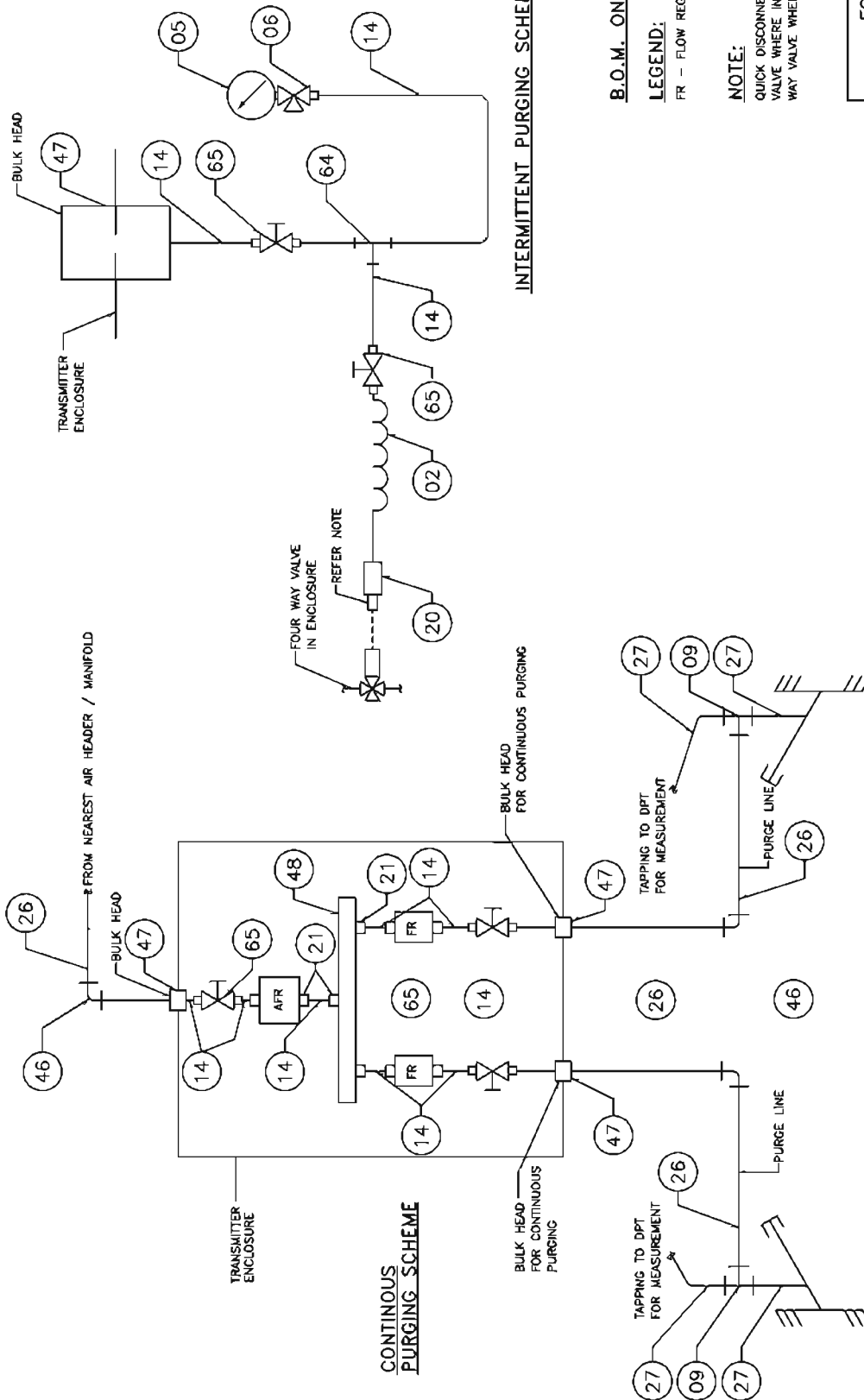
MAHARASHTRA STATE POWER GENERATION CO.LTD.	BRUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT
TYPICAL INSTRUMENT INSTALLATION DIAGRAM	

FOR RD ISSUE ONLY	CLEAR	DATE
DEPT	SIGNATURE	DATE
CHEM		
CIVIL		
ELEC		
MECH		

BY	CHEM	CIVIL	ELEC	MECH

REVISIONS	DATE	APPD	DATE

TYPICAL AIR PURGING SCHEMES



B.O.M. ON SHT. NO. 16 OF 20

LEGEND:
FR - FLOW

NOTE:

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MAHARASHTRA STATE POWER GENERATION CO.LTD.
 **MANAGEO**
 BHUSAVAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT
DO NOT SCALE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

PROCON ENGINEERS
(DIVISION OF NDT/OTO CONSULTING ENGINEERS)

	SCALE ~			DATE (NO ISSUE)
DIV.	INST.	APPROVED		DATE (CURRENT RESO) 23-08-2011
DRG	P.N.Z.			
CH	D.M.P.		DRWG NO PE-189-IN-SK-8003 (REV 15 OF 40)	ISSUE P0

[illegible][illegible]

BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
27	15MTRS.	IMPULSE PIPE 3/4" NB, CS/AS.
26	A/R	GI PIPE, 1/2" NB.
09	2	FORGED UNEQUAL TEE AS PER ANSI B16:11 SIZE: 2 x 3/4" NB SW x 1/2" NPTF, CL 3000.
46	3	GALVANISED ELBOW CL 3000 SIZE: 1/2" NPTF.
20	1	QUICK DISCONNECTING FITTING MALE/END CONN. TO SUIT 1/2" OD CONN.
02	A/R	NYLON NOSE TO SUIT 1/2" END CONN. PR. TESTING 10 Kg/cm ² g.
14	A/R	SEAMLESS TUBE 1/2" OD, 2.1mm THICK, SS 316.
47	3	BULK HEAD COUPLING TO SUIT 1/2" OD TUBE & 1/2" NB PIPE, SS 316.
65	5	BALL VALVE 1/2" NPT(F), SS 316.
21	18	MALE CONNECTOR 1/2" NPT(M) x 1/2" OD 3000lbs, SS 316.
48	1	INSTRUMENT AIR HEADER 1" NB PIPE, SS 316.
64	1	EQUAL TEE, SS 316, TO SUIT 1/2" OD TUBE.
05	1	PR. GAUGE, 4" DIAL SIZE, RANGE 0-10 Kg/cm ² g CONNECTION 1/2" NPTM
06	1	3 WAY GAUGE COCK 1/2"NPTF x 1/2" OD.

FOR BID PURPOSE ONLY

DO NOT SCALE

DATE : 23-08-2011

ISSUE BY CH DATE

PROCON ENGINEERS
(DIVISION OF NIMOTO CONSULTING ENGINEERS PVT. LTD.)

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

CLIENT : MAHARASHTRA STATE POWER GENERATION CO.LTD.

SCALE ~

APPROVED

PROJECT : BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT

DIV INST.

DR P.N.Z.

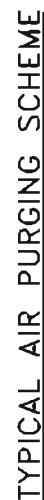
CH D.J.P.

DWG.NO.PE-189-IN-SK-8003

(SHEET 16 OF 20)

PD

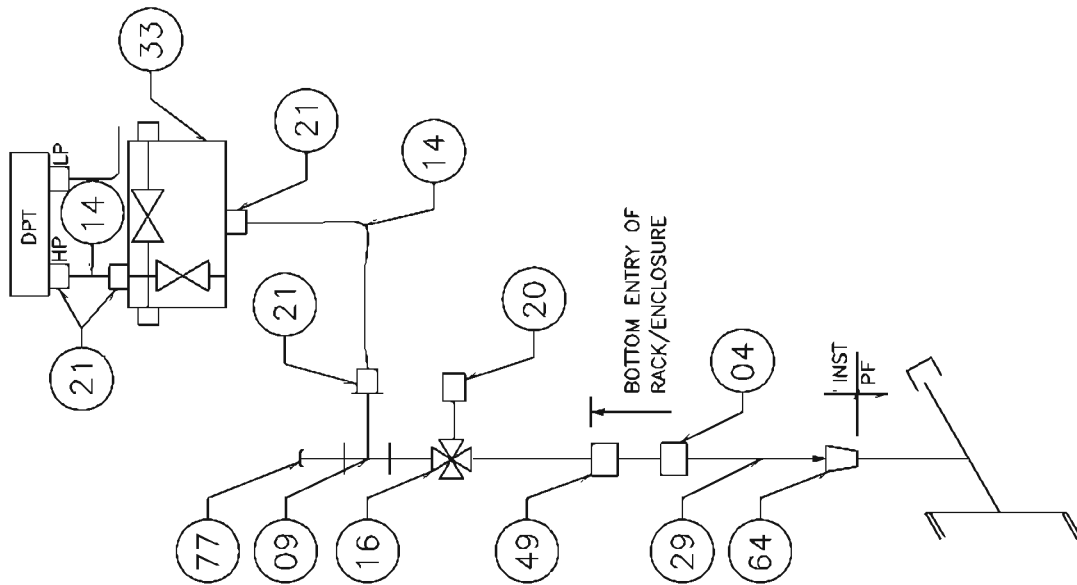
SERVICE : FLUE GAS, FURNACE ETC.



DO NOT SCALE

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DIFF. PRESSURE TRANSMITTER MOUNTED ABOVE SOURCE POINT



BILL OF MATERIAL		
ITEM NO.	QTY./INST.	DESCRIPTION
64	1	REDUCER 1" BSPF x 3/4" NB-SW CL 3000
04	1	FORGED COUPLING 3/4" SW CL 3000. AS PER ANSI B16.11
09	1	FORGED UNEQUAL TEE AS PER ANSI B16.11 SIZE : 2 x 3/4" NB-SW x 1/2" NPTF. CL 3000
77	1	NIPPLE & CAP 3/4" NB-SCH 80.CAP-3/4" NPTF, CS/AS
14	6 MTRS.	SEAMLESS TUBE 1/2" OD, x 2.1mm THK., SS 316
16	1	FOUR WAY VALVE SIZE : (2 x 3/4" NB-SW)x(2 x 1/2"NPTF) CL 800.
20	1	QUICK DISCONNECTING FITTING SIZE : 1/2"NPTM
21	5	MALE CONNECTOR, SS 316 1/2" NPT(M) x TO SUIT 1/2" OD TUBE
29	30 MTRS.	SEAMLESS PIPE/3/4" NB SCH 80
33	1	2 VALVE MANIFOLD 1/2" NPT(F), SS 316
49	1	BULK HEAD COUPLING SIZE : 3/4" SW, CL 3000 lbs AS PER ANSI B16.11

SERVICE : FLUE GAS, PRIMARY AIR, SECONDARY AIR ETC.

NOTE:

- AIR PURGING ARRANGEMENT SHALL BE INCLUDED.

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SCALE	~	APPROVED	DATE/REV ISSUED
BY	INST.		DATE/ISSUED
BY	P.N.Z.	DATE/ISSUED	23-08-2011
BY	D.J.P.	DATE/ISSUED	PE-189-IN-SK-8003 Rev 18 of 30 PD
MAHARASHTRA STATE POWER GENERATION CO.LTD. BHUSAWAL T.P.S. UNIT-6 : 1 X 660 MW PROJECT		TYPICAL INSTRUMENT INSTALLATION DIAGRAM	
FOR ISSUE ONLY		Cleared	
BY	CHEN	DATE	
BY	CIVIL	DATE	
BY	ELEC	DATE	
BY	MECH	DATE	
REVISIONS	BY	DATE	
ISSUE	BY	DATE	



LEGEND:

- A/R - AS PER REQUIREMENT
SOV - SOLENOID VALVE
AFR - AIR FILTER REGULATOR

NOTES:

1. ALL TUBE FITTINGS ARE OF DOUBLE COMPRESSION TYPE AND OF SS 316 MATERIAL.
2. QTY. SHOWN ARE TYPICAL FOR ONE INSTALLATION ONLY.
3. TUBE & FITTINGS MARKED ARE ■ INTEGRAL TO THE VALVE.
4. JUNCTION BOX WILL BE INTEGRAL TO ACTUATOR.
5. ISOLATION VALVE SHALL BE INSTALLED CLOSE TO THE VALVE ASSEMBLY.

FOR BID PURPOSE ONLY

[illegible]



LEGEND:

- AS PER REQUIREMENT
- POSITIONER TRANSMITTER
- AIR FILTER REGULATOR
- INSTRUMENT AIR

NOTES:

1. ALL TUBE FITTINGS ARE OF DOUBLE COMPRESSION TYPE AND OF SS 316 MATERIAL.
2. QTY. SHOWN ARE TYPICAL FOR ONE INSTALLATION ONLY.
3. TUBE & FITTINGS MARKED ARE ■ LIMIT SWITCHES TO THE VALVE.
4. LIMIT SWITCHES WILL BE CONNECTED WHEREVER APPLICABLE.
5. JUNCTION BOX WILL BE INTEGRAL TO ACTUATOR.
6. ISOLATION VALVE SHALL BE INSTALLED CLOSE TO THE VALVE ASSEMBLY.

FOR BID PURPOSE ONLY

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**TITLE:**

**TECHNICAL SPECIFICATION FOR
PRE TREATMENT PLANT (PT PLANT)
1X660 MW BHUSAWAL TPS, UNIT # 6**

BHEL DOCUMENTS NO.: PE-TS-415-158A-A001

VOLUME II-B

SECTION-C4

REV. NO. 00

DATE:

**SECTION-C4
(SPECIFIC TECHNICAL REQUIREMENT-CIVIL)**



TITLE:

**TECHNICAL SPECIFICATION FOR
PRE TREATMENT PLANT (PT PLANT)
1X660 MW BHUSAWAL TPS, UNIT # 6**

BHEL DOCUMENTS NO.: PE-TS-415-158A-A001

VOLUME II-B

SECTION-C4

REV. NO. 00

DATE:

1.0 SCOPE OF CIVIL WORK

Total Civil works (excluding chemical house & Centrifuge Shed) is in bidder's Scope of work. The scope includes complete analysis ,design, supply of cement, steel (reinforcement, structural etc.) including bar bending , aggregate, and admixtures and any other material required for completion of civil work, construction, erection of all civil structural & architectural works of complete pretreatment plant area including but not limited to excavation, backfilling, encasing of pipes, foundation of equipment and pedestals, brick work (as required), plastering, PCC, painting, shuttering, Pipe & cable pedestal, associated walkways, pathways, interconnecting platforms, handrails, staircases, plinth protections, peripheral drains, acid & alkali resistance tiling/bricks, paintings for civil structures, material required for grouting of equipment foundations, fixing and any concreting inside the vessels and lining, any other material as specified elsewhere in the specification.

The civil works including operating / maintenance platforms and interconnection platforms (if any) with ladders / stairs & handrails, structural supports and hangers for pipes / cables / ducts, crane rails, all embedment's and inserts with lugs including anchor fasteners, bolts etc., grouting of pockets and underpinning of base plates for equipment / structures and fixing supports, filling and finishing of openings in walls, floors, cladding, roof and trenches shall be in bidder's scope.

The RCC to be considered is M30 grade & the reinforcement to be considered as Fe 500/Fe5000D.

Bidder to consider the following but not limited to major items of PT plant excluding Chemical house and centrifuge shed.

- PT-Aerator, Stilling Chamber, Flush Mixure, Parshall flumes, Interconnecting channels, Inlet chambers, telescopic chambers etc.
- PT -Clarifiers, outlet channels up to gravity filter etc.
- Gravity filters, gravity filter house, overhead filter back wash tank, blower house, gravels & sand required for filters etc.
- Clarified water storage tank and pump house for DM.
- Sludge Pit For PT- DM and Non-DM Clarifier including inlet & outlet chambers etc.
- Thickener and associated sumps and pits
- Thickened waste sump including inlet & outlet chambers.
- Sludge transfer pump house, thickened sludge transfer pump house, blower house etc.
- Foundation of equipment, Pipe & cable pedestals, associated walkways, pathways, interconnecting platforms, RCC staircases, plinth protections, peripheral drains along with cover, filling and finishing of openings in walls, floors, cladding, roof and cable trenches along with cover etc for the complete pretreatment plant as per technical specifications.
- Any other civil structure required for completion of PT plant.

During Civil design while furnishing the drawing /design for BHEL's & Customer Review/approval, Bidder shall furnish the designed quantiles of Reinforcement steel & Concrete in Drawing/Documents.

2.0 DISPOSAL POINT OF SURPLUS EARTH/SOIL

Bidder to consider distance of disposal area from PTP plant within 8KM approx.



MAHAGENCO

**MAHARASHTRA STATE POWER
GENERATION CO. LTD.**

**PROJECTS & PLANNING
DEPARTMENT**

BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1

VOLUME – VI A

**TECHNICAL SPECIFICATIONS FOR
CIVIL, STRUCTURAL AND ARCHITECTURAL
WORKS**

**CONSULTANT
PROCON ENGINEERS**

(DIV. OF NIMOTO CONSULTING ENGINEERS PVT. LTD.)

**Venus Building, 2nd Floor, Opp. Digha Talao,
Plot No. 8, TTC Industrial Area, Thane-Belapur Road,
Digha, Airoli, Navi Mumbai - 400 708.**

2011



**MAHARASHTRA STATE POWER
GENERATION CO. LTD.**

**PROJECTS & PLANNING
DEPARTMENT**

BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1

VOLUME – VI-A

**TECHNICAL SPECIFICATIONS FOR CIVIL,
STRUCTURAL AND ARCHITECTURAL
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